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O. P. BRYSCH, Editor **P. J. CHATTA, Assistant Editor**

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1. MANAGEMENT

Federal Power Commission

Opinion and Order Determining Cost of Service and Termination Proceedings. U.S.A. Federal Power Commission Opinion No. 338 (re Phillips Petrol. Co.) Issued Sept. 28, 1960; **FPC Maps New Gas-Regulation Policy.** C. La Motte. *Oil Gas J. 58,* 56 (1960) Oct. 3 (5 pp); **FPC's New Policy: Producers Are Hopeful, but Skeptical.** H. D. Ralph. *Oil Gas J. 58,* 101 (1960) Oct. 10 (2 pp.); **What Next? FPC Isn't Altogether Sure.** *Ibid.,* 102 (1960) Oct. 10; **FPC Gas Policy Is Scorned, Cheered, and Headed for Fast Test in Courts.** *Petrol. Week 11,* 15 (1960) Oct. 7 (3 pp.)

Federal Power Commission has served notice on Congress, the courts, its staff, and everybody else that the cost-of-service rate-base formula has been abandoned as unworkable, that gas producers are not to be regulated at utilities, and that gas must be priced as a commodity. Congress, while inclined to wait and see regarding the new policy, thinks that the plan will not work and in a couple of years things will be even worse. A contrary view—held by an equal number—is that this will hasten legislation of the proper kind. It is certain that the FPC is feeling its way into a new field in its policy of setting producer gas prices by area ceilings instead of the cost-of-service formula. Chairman Jerome K. Kuykendall made it plain that the FPC is prepared to experiment, to seek practical solutions to individual problems as they arise, to develop procedures gradually, to issue additional policy statements, and perhaps to change its mind.

Gas Industry Expansion

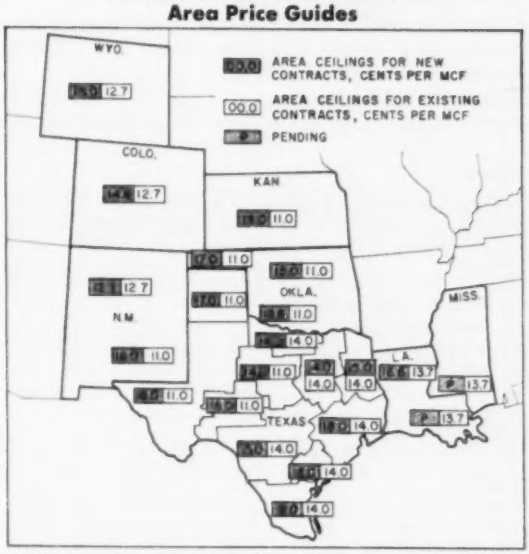
Natural Gas Comes to Alaska. *AGA Monthly 42,* 4 (1960) Sept. (3 pp.)

Residents of Anchorage will begin receiving natural gas by November, 1960, when a new $17 million pipeline and distribution system goes into operation, according to announcements by the recently-enfranchised local utility, the Anchorage Natural Gas Corporation. Completion of a transmission line approximately 80 miles long by Alaska Pipeline Company will link the state's largest city with wells discovered last year on the Kenai Peninsula. The $12.8-million 12¾-in. pipeline will have a capacity of 71 MMCF without compression. Anchorage Natural Gas Corporation is completing a $4-million distribution system to serve Anchorage and the public utility district of suburban Spenard.

The Economics of Gas Main Extension for Agricultural Use. L. E. Nelson. *Gas Age 126,* 52 (1960) Sept. 15 (4 pp.)

Kansas-Nebraska Natural Gas finds special attention to the agricultural load is profitable in several ways—direct dollars of profit, better load balance, improved ability to serve residential markets in thin areas, and promotion of a better economy generally in the service area.

Federal Power Commission's Area Price Guides



(Adapted from *FPC Gas Policy Is Scorned . . .* See Abstract at left)

Financing the Expansion Program of the Natural Gas Transmission Industry. P. G. LaGrone. *Public Util. Fortnightly 66,* 535 (1960) Oct. 13 (15 pp.)

Natural gas industry is the sixth industry in size in the U.S. To take advantage of a waiting market, the industry has conceived a gigantic construction schedule covering the next four years. With debt issues affording an almost certain return to conservative investors and common stock being in great demand, money for the expansion seems assured. Construction is currently at an all-time high, with the schedule over the next four years calling for expenditures totaling $3.5 billion.

Gas Air Conditioning Moves Ahead. G. T. Kellogg. *Public Util. Fortnightly 66,* 525 (1960) Oct. 13 (10 pp.)

With research continuing and with the promotion and advertising efforts of the A.G.A., along with the growing number of gas companies throughout the country which are joining the movement, gas air conditioning is making steady gains in its uphill battle against already established electrically powered air conditioning.

The Impact of Cost Allocations upon Future of the Natural Gas Industry. H. E. Nissel. *Public Util. Fortnightly 66,* 512 (1960) Oct. 13 (13 pp.)

Sound and economic development in the years to come will require careful and prudent planning on the part of the gas industry and judicious appraisal by the Federal Power Commission. The industry may easily get hurt by uneconomic expansions into new markets and into new types of service. This is particularly true of low load factor peak and winter services if such services are rendered at noncompensatory rates. Article reviews the major issues in connection with cost allocations presented in recent rate and certificate cases with their economic repercussions.

Air Pollution

Publications. Section 1. Air Pollution. The Robert A. Taft Sanitary Eng. Center Tech. Rep. A60-9. (U.S. Public Health Service, July 1960.)

Report lists all publications as of July 1, 1960, including journal articles, training reports and manuals.

Butane

The Butane Storage Problem. A Survey of the Situation, Present and Future. W. M. Bone and M. J. Hanlon. *LP-Gas 20,* 21 (1960) Oct. (4 pp.)

Rapidly increasing sales of butane to the petrochemical industry threaten a shortage for domestic use in southern and southwestern areas. In this survey, the magazine has selected opinions of leading producers and marketers of the region.

Corrosion

Top Management Will Look at Corrosion Control. R. M. Shepard. *Am. Gas J. 187,* 36 (1960) Sept. (6 pp.)

Niagara Mohawk Corp. (Syracuse, N. Y.) conducts studies of corrosion of gas services—related to age of services, reported leaks and soil types—and provides management with data useful in making decisions on corrosion mitigation, and replacement. Author describes procedure for applying simple statistical techniques to the interpretation of a great mass of rudimentary field data.

Customer Service

Quality and Cost Control on the District. B. G. H. Clegg. *Gas Service 39,* 475 (1960) Sept. (5 pp.)

Author describes the experiences, surveys and practices used by the Southern Gas Board (Great Britain) to evaluate the quality of work done by its gas fitters and maintenance men.

Education

Is Horizontal Education Lying Down? M. F. Heldt. *Research/Development 11,* 115 (1960) Sept. (7 pp.)

U.S. educational philosophy has been one primarily of vertical accumulation of information—one layer added to the next with little attempt to coordinate or fuse the whole into a framework of knowledge. While ideally suited to specialization, it remains more a tradeschool instruction—even in the complex sciences—than truly an education. Horizontal patterns, in contradistinction to the vertical, originated long before education was conceived as the right and privilege of every man. And it is true that although it does produce untrained men in the accepted sense of training, it does turn out educated men.

Schools a Rich Reservoir for Free Enterprise. R. S. Knowles. *Independent Petrol. Assoc. Monthly 31,* 24 (1960) Sept. (4 pp.)

Industry has more friends in the academic world than it is aware of, but . . . must seek them out and support them in their efforts. Author reports on her 14 college and university talks on behalf of the Coe Foundation's American Studies Programs and analyses the reactions of hundreds of educators to her addresses on oil and the free economy.

Fire Safety

Chlorine Inhibition of Carbon Monoxide Flames. H. B. Palmer and D. J. Seery. *Combustion and Flame 4,* 213 (1960) Sept. (9 pp.)

Chlorine and bromine reduce the burning velocities of hydrogen-containing carbon monoxide flames supported by air, oxygen and nitrous oxide, with the qualification that if the hydrogen content is low, the effect of chlorine upon nitrous oxide-supported flames can become an acceleration caused by chlorine catalysis of nitrous oxide decomposition. Measurements of the reduction of S_u by chlorine over a wide range of carbon monoxide-air compositions show that the relative change in $(S_u)^2$ with an increment of chlorine is, at most, only weakly dependent upon the carbon monoxide-air ratio or upon the hydrogen content. The effect of carbon tetrachloride reported by Drozdov and Zeldovich is found to be identical to the equivalent amount of chlorine.

Mechanisms of Extinction of Liquid Fires with Water Sprays. R. J. Rasbash, Z. W. Rogowski and G. W. V. Stark. *Combustion and Flame 4,* 223 (1960) Sept. (12 pp.)

Investigation has been carried out on the extinction by means of water sprays of fires or liquids burning in a vessel 30 cm in diameter. The effect on the ease of extinction of (1) the nature of the liquid, (2) the time between the ignition of the fire, and the application of the spray, (3) the properties of the sprays and (4) the direction of application of the spray have been studied. It was found that liquids like kerosine, which can be extinguished by being cooled to the fire point, or by being diluted, like alcohol, could be extinguished reliably by certain water sprays, although in some cases the extinction took a long time. For liquids like petrol and benzole, extinction depended primarily on whether or not stable flames close to the burning liquid surface were easily established following the application of spray. These stable flames were very difficult to extinguish and were usually established readily when the preburn time was very short (less than 6 to 10 seconds) and also when the spray was applied in a horizontal direction across the fire.

Foreign Activities

The Effective Use of Coal Through Gasification. A. Baba. World Power Conference, Sectional Meeting, Madrid; *Gas World 152,* 360 (1960) Sept. 10 (2 pp.)

Energy resources of Japan are very poor, amounting to not more than 1% of the known world reserve. Among them hydraulic power heads the list representing 54%, followed by coal with 40% and wood and charcoal 5%, other items being almost negligible. The emphasis, therefore, is to be laid upon coal as an important indigenous source of energy while the worldwide tendency of switching from solid to fluid fuel is at present very

prevalent in Japan. This includes gasification of coal waste for effective use of total energy contained therein; and gasification of coal in respect to coal transportation.

French Natural Gas Wells at Lacq. L. T. Minchin. *Chem. & Ind.*, 1178 (1960) Sept. 17 (4 pp.)

Article discusses technical problems encountered in developing France's Lacq storage field. For example, the gas pressure, 670 atm, combined with its high temperature and its acid gas content, presented a technical problem which, with others, prevented commercial exploitation of the field for six years (until 1957). When production is in full swing, the Lacq deposits will be worked at the rate of 20 MMCM/day (700 MMCF) of crude gas, but this will be in four separate units. The last two quarters, now under construction, will begin operation next year. When all four phases are operating, the yearly output will be: purified gas, 140,000 MMCF; propane and butane, 130,000 tons; petrol, 260,000 tons; and sulfur, 1,400,000 tons.

How Three Oil Men Size Up Russia. *Oil Gas J. 58*, 72 (1960) Sept. 12 (3 pp.)

Bone weary after a full month spent in sampling the sprawling industry, a trio of U. S. oil executives—W. W. Keeler, Ira H. Cram and George T. Piercy—landed at New York with some definite ideas, and several unanswered questions, about Russian achievements and plans. They are firmly convinced that the Soviet Union will not only achieve its 7-year plan of 4,800,000 bbl/day of crude oil by 1965, but may well surpass it.

Kaita Gasworks—Hiroshima. *Coke and Gas 22*, 374 (1960) Sept. (8 pp.)

Notes on the construction and operation of the new Kaita Works of the Hiroshima Gas Co., which supplies all the gas to the new town and to nearby Kure. Chief gas producing plant of the new operation, which was inaugurated in May 1958, is a battery of 20 combination coke ovens having a carbonizing capacity of 230 tons of coal/day producing 100,000 CM (3,500,000 CF) of coal gas.

Gas Lighting

"Gasigns." *A.G.A. Monthly 42*, 8 (1960) Oct. (3 pp.)

Company that sparked rebirth of gaslights, Arkansas-Louisiana (Arkla) Gas Co., and developed a 25-ton water chiller-heater, has announced another new gas load-builder—the "Gasign." This is a completely gas-operated illuminated sign for commercial establishments. It consists chiefly of two specially developed frosted glass side panels, for the user's advertising message, mounted on a metal frame, with a row of mantle-covered gas burners inside.

More Than a Fad . . . the Resurrected Gas Lamp. J. H. Collins. *Public Util. Fortnightly 66*, 550 (1960) Oct. 13 (10 pp.)

There is solid marketing motivation in the sudden urge to sit under an early General Grant street light. Other industries are capitalizing on nostalgia for things of yesteryear, so why not gas? It has given the gas industry a million dollars worth of publicity as well as additional revenue.

Personnel

White Collar Unionization—Challenge to Management. J. J. Bambrick. *Petrol. Refiner 39*, 305 (1960) Sept. (8 pp.)

Author believes that management should take time to consider the five main reasons why white collar workers join unions, and sometimes even seek out union organizers. Author gives what he believes is a reasonable solution to an ever-growing problem.

Pipeline Construction

Here Is the New Mid-America Pipeline—World's First Major LPG System. *Oil Gas J. 58*, 123 (1960) Oct. 10 (26 pp.); **First Major All-LPG Pipeline Will Be Operating by December.** R. E. Thomas. *Ibid.*, 124 (4 pp.); **Laying Schedule Required Exact Timing.** V. E. Butler and E. M. Hubach. *Ibid.*, 127 (3 pp.); **How Mid-America Was Built.** G. H. Beck *et al. Ibid.*, 130 (19 pp.)

First major LPG system is an 8- to 10-in. line that extends from Eunice, N. M., to McPherson, Kansas, with branches to Minneapolis, Minn., and Madison, Wis. The $67-million, 2200-mile line has a capacity of 50,000 bbl/day. In first article of three, Mid-America's president tells how company breaks pipeline precedents, how it will function, who owns it and what it intends to accomplish. Second article tells of the near-simultaneous performance of the engineering, right-of-way acquisition, material procurement and construction personnel. Last article is divided into eight parts to describe in full the features representing advanced modern practice in pipeline operation.

Codes, Standards and Industry. A. G. Barkow. *Pipe Line News 32*, 22 (1960) Sept. (6 pp.)

Codes and standards are controlling factors in construction, fabrication and operation. Frequently the necessity for control is questioned. Yet it is almost axiomatic that, as engineering and construction practices advance, codes and standards become more stringent. Codes and standards are the common language of the designer, the engineer, and the fabricator. Codes and standards are the common denominator of safety and economy. Author discusses definitions, values, authorship, basis, applications and support by large and small companies.

Promotion

Gas Industry Forges Keys to Competition. W. H. Ligon. *Public Util. Fortnightly 66*, 505 (1960) Oct. 13 (7 pp.)

Increased sales and added revenues are the rewards that aggressive gas companies will win in the next decade by climbing aboard the big advertising and promotion push sparked by the American Gas Association on behalf of the gas utility industry. As new uses for gas are developed they must be sold intensively. Residential load will rise only where a total selling effort is

made. Only that kind of effort will produce topnotch results in this highly competitive energy age, says author.

Research

Petroleum Research Group Works for Industry, Texas. P. B. Crawford. *Independent Petrol. Assoc. Monthly 31,* 34 (1960) Sept. (3 pp.)

Texas Petroleum Research Committee was created by joint resolution of the Railroad Commission of Texas, the board of directors of Texas A and M College and the Board of regents of the University of Texas in January 1948. Objectives of TPRC are six-fold: 1) to conduct research for the purpose of increasing the ultimate recovery of oil from Texas oilfields; 2) to conduct periodic oil and gas recovery conferences; 3) to conduct special regional conferences on oil recovery problems of particular interest and importance; 4) to conduct surveys, studies and reports on technical problems of the oil industry; 5) to publish all research, conferences and surveys for distribution to the public; and 6) to train skilled research workers and specialists for the petroleum industry of Texas.

Reconciling Professional and Personal Goals and Needs with Company Goals and Needs. Section A—Nature of the Problem and Approaches to Solution. (From the 11th Annual Industrial Research Conference, August 7-13, 1960; held at Columbia University, New York.) *Research/Development 11,* 5 (1960) Oct. (7 pp.)

Widespread and major problem encountered in the administration of research and development is the difference between the professional and personal goals and needs, and the goals and needs of the company. It is, in fact, a problem inherent in all individual-organization relationships. As one authority points out, "Differences in expectations, values and organizational traditions between the laboratory staff and the rest of the company are often reflected in the dissatisfaction of research and development (personnel) and in managerial doubts and misunderstandings. The difficulty of evaluating research and development activity adds to the instability of the relationship." There is a "gulf of mutual incomprehension" between research and the rest of the company.

Safety

Five Steps to Safety: Boston's 10-Year Fight. E. H. Eacker. *AGA Monthly 42,* 19 (1960) Sept. (2 pp.)

Utility companies or any management seeking to cut down industrial accidents will be interested in the safety program of Boston Gas Company, which rang up one of the country's outstanding records in accident prevention in 1959. Here is Boston Gas' record for the year: 1) a 1.98 accident frequency rate, 75% below the national average of the gas industry and 80% below the average of industry across the nation; 2) only eight lost-time accidents among 1900 employees over the entire year; and 3) an impressive stretch of over 2,000,000 consecutive man-hours without a lost-time accident in 1959. (This record was extended into 1960 to a total of 2,609,963 man-hours without a lost-time accident.)

Well Practice

For Lease: Oilfield Equipment. R. Sheridan. *Drilling and Producing 32,* B-47 (1960) Sept. (3 pp.)

Petroleum industry is leasing more equipment now than ever before. Last year, it leased some $30.4 million worth of equipment, a gain of 58% in 12 months. Equipment being leased includes both standard drilling and pumping equipment, specialized equipment of many types, office machines, data processing equipment, refinery machinery, and virtually every type of machinery used in exploration, production, refining and marketing of petroleum.

2. ENERGY SUPPLY AND ECONOMICS

Natural Gas

Home Markets Offer Growing Outlet for Texas-Louisiana Gas Reserves. R. L. Conkling. *World Oil 151,* 84 (1960) Sept. (2 pp.)

Real significance of Texas and Louisiana gas markets has been obscured by the tremendous growth of interstate pipe lines. In fact, the U. S. Supreme Court recently noted that "some 90% of all commercial gas moves into the interstate market." In reality, Texas and Louisiana accounted for nearly half of the nation's industrial consumption during 1958. Article reports on the demand potential within these two states, with exclusive statistics showing the inroads natural gas and imports have made in U. S. crude oil production growth.

Bituminous Sands

Exploratory Techniques Today in the Athabasca Sands Area. W. B. Gallup. *World Petrol. 31,* 54 (1960) Sept. (3 pp.)

About 300 miles north of Edmonton (Canada), are the Alberta oil sands, the world's largest known reserves of hydrocarbons—over 40 billion bbl of recoverable oil at or near the surface and over 270 bbl of estimated total reserves. Review of exploration techniques is followed by recent pictures of the research project to find methods of recovering usable oil from the Athabasca sands.

Competitive Fuels

Freedom of Choice and a Free Economy. H. C. Brunie. *Fueloil and Oil Heat 19,* 49 (1960) Oct. (4 pp.)

Article attempts to bring about a broader public understanding of the National Fuels Policy issue, in the belief that an informed public will support competition, not restraint, as the key to continued prosperity.

Electricity

Competitive Nuclear Power for Canada. W. B. Lewis. *Nucleonics 18,* 54 (1960) Oct. (6 pp.)

In the industrial region of Southern Ontario, the total

demand for electric power is rising by more than 200 Mw(e) each year. It is expected that annual demand for new generating plant will double within fifteen years. With the completion of the St. Lawrence Seaway, the available water power has been almost all harnessed. Th new demand for power is being met by the installation of large-capacity thermal plants, notably the 1800 Mw(e) Lakeview plant, near Toronto, burning coal imported from the U.S. at $8.00-9.00/ton. The present price of coal sets the level at which nuclear power must compete; coal prices may rise, but if they do, oil and natural gas will come in, which, together with possible improved efficiencies, will hold the cost of fossil-fuel power at its present level for the next two decades.

Energy Sources

Energy Resources in Scotland. J. Henderson. World Power Conference, Sectional Meeting, Madrid; *Gas World 152*, 362 (1960) Sept. 10.

The trends of annual consumption of energy are expressed in terms of equivalent tons of coal. The annual coal consumption figures for various purposes from 1948-1958 show that there is a general decline in the use of coal as a source of energy for many purposes. Work commenced on the construction in Fife of a large high pressure complete gasification plant (Lurgi) with an ultimate capacity of 30 million cubic feet of gas per day and designed to gasify poor quality non-coking unwashed opencast coal. The coal (about 400,000 tons per annum) will be transported to the plant by a relatively short conveyor direct from an adjacent opencast mine. A contract for the supply of this coal for a period of 20 years has been made with the Coal Board.

Fuel Cells

Fuel Cells: Introduction. L. D. McGraw. (From a paper presented to the SAE summer meeting, June 5-10, 1960.) Paper No. 179A, 10 pp.

Concept of fuel cell dates back to the early history of the development of batteries as sources of electrical energy. Fuel cells do not differ in principal from batteries; but, they are maintained by a continuous rather than fixed supply of chemical reactants or fuel. This introduction to the symposium on fuel cells is intended to explain the technical and economic aspects of battery power sources. It is written for the uninitiated as an aid to recognizing advances in research toward a practical fuel cell.

Nuclear Energy

The Consumer's Requirement for Commercial Nuclear Power. R. C. Woodbury. *Public Util. Fortnightly 66*, 361 (1960) Sept. 15 (6 pp.)

Nation's (U.S.) concern for pushing commercial nuclear power seems grossly out of proportion to the facts. Actually, U.S. now has nuclear power that is competitive to power costs in many foreign countries. And cost is not important from a defense standpoint. Reserves or fossil fuels are such that there should be no anxiety that they may run out. Moreover, the many projects and plans now being completed or under way by privately owned electric utility companies demonstrate that the U.S. will sustain its leading role in developing nuclear energy. The government could well place its emphasis somewhere else without fear or risk, author believes.

Petroleum

Past and Future. The Economic Impact of Oil. T. H. H. Skeet. *Petroleum 23*, 373 (1960) Oct. (4 pp.)

The last decade or two have witnessed a remarkable change. Immediately after World War II it seemed that neither price nor quality could assail the undisputed monopoly of coal. Times have changed, and while coal remains the basic fuel in the United Kingdom, oil has emerged as a formidable competitor. Characteristic of contemporary times, the fact remains that the leading industrial nations in the Eastern Hemisphere, including Western Europe and the U.S.S.R., have followed much the same course and sought the use of oil in solving their energy problems.

Solar Energy

Solar Energy Converter. E. D. Jackson (assigned to Texas Instruments Inc.) U.S. 2,949,498 (1960) Aug. 16.

Solar energy converter is claimed in which several photoelectric semiconductor elements are stacked to form a more efficient power generator. The semiconductor elements are chosen so that approximately equal currents will be generated in each layer, but each has a different energy gap. For a certain solar wavelength region, each semiconductor element generates most efficiently and is transparent to shorter wave lengths, permitting these to pass into the next lower element and produce hole-electron pairs. Thus, silicon alone has only 11% conversion efficiency, but this is raised in a cadmium selenide-silicon-gallium antimonide combination to 17.4%.

Thermoelectricity

Thermoelectric Air Conditioning Apparatus. J. F. Belton, Jr. and L. Swerbinsky (assigned to Whirlpool Corp.) U.S. 2,949,014 (1960) Aug. 16.

Thermoelectric air-conditioning system is claimed, in which two sets of thermocouples are used. The first set has cold junctions exposed to the space to be cooled. Its hot junctions are spaced away and are cooled by a separate stream of outside air. The cooled room air, after passing through moisture-absorbing apparatus, is recycled through the room. Reversal of the direct current would cause the junction plates to heat the room.

Where Is Thermoelectricity? *Appliance Manufacturer 8*, 71 (1960) Sept. (3 pp.)

Thermoelectrics can be used for three things—cooling, heating, and for the generation of power. Major advances have been made in using this material for cooling purposes by developing materials in the semiconductor field which have a high Seebeck coefficient,

electrical resistivity approaching those of metals and very low thermal conductivity. These material parameters are important since they determine the thermodynamic efficiency as well as the temperature difference which can be obtained.

3. NATURAL GAS AND PETROLEUM PRODUCTION

Drilling

Attrition—A Progress Report. R. O. Frederick. *Drilling 21,* 53 (1960) Oct. (3 pp.)

Of all contractor-owned idle rotary rigs in the U.S. and Canada today, 88% could go to work simultaneously tomorrow morning without purchase, lease or rent of additional capital or major expendable equipment. This is the concensus of 379 contractors who own 40% of the 3411 contract rotaries available for work in the U.S. and Canada. Among the rigs of those 379 contractors are 47% of the 1078 idle contract rotaries on the domestic scene today. Equipment men, on the other hand, say the 88% figure is too high.

How Humble Plans for Minimum Drilling Costs. E. McGhee and C. Hoot. *Oil Gas J. 58,* 146 (1960) Sept. 26 (4 pp.)

Humble, a pioneer in optimum drilling, calls its system MCD—minimum-cost drilling. Under this system, the company uses bit weights and rotary speeds which have been scientifically calculated. Object of the calculations: find the combinations of weight and speed which drill the hole at the lowest possible cost. These calculations are necessary because no human brain can possibly juggle simultaneously all the many things which affect the cost of a foot of hole.

More from Drilling-Rig Engines. E. McGhee. *Oil Gas J. 58,* 123 (1960) Sept. 26 (22 pp.)

Drilling contractors spend more money each day to keep rig engines running than for any other item except labor. Most of the daily engine expense is for fuel. Even though cost of routine maintenance, repairs and depreciation is less, the engines represent a large expense in all these areas. Thus, no contractor can afford a casual approach when buying and operating his power plant. Article discusses: selecting the right engine; careful operating pays dividends in good service and low maintenance; trouble shooting on the rig engine; good maintenance means long life; the rig engine's cooling system; fuels—and fuel-handling equipment; and turbochargers—their job and care.

The Story Behind Gulf's Mile-a-Day Drilling Record. R. Gross. *Drilling and Producing 32,* B-21 (1960) Sept. (3 pp.)

Author describes combination of rotary speeds (up to 250 rpm) bit weights (60,000 lb) and 640 gpm of mud at 3000 psi which enabled Gulf Oil Corp. to drill 5412 ft in 24 hr.

What's the Future of Big-Hole Drilling? Better Techniques, Equipment Needed. R. Sneed. *World Oil 151,* 109 (1960) Oct. (2 pp.)

Present available air drilling knowledge can take the fullest advantage of the present and potential big-hole markets, says author. The present markets and customers are relatively few. Many more markets can be opened by combining the "far out" approach of the visionary with the hard pencil pushing of the engineer. Approach is naturally to consider all drilling in terms of what air has done and what it might be made to do. Problem, too, is the economics of developing the engineered equipment to take advantage of a limited market. First thoughts are how to create new markets to amortize development costs more rapidly while drilling big holes for the few customers initially.

What's the Future of Big-Hole Drilling? Larger and Deeper Holes Predicted. C. R. Woodruff. *World Oil 151,* 108 (1960) Oct. (2 pp.)

Author believes that its future assured, big-hole drilling is limited only by the ingenuity and resourcefulness of drilling contractors who, heretofore, may have felt their income was limited only to drilling conventional oil wells. Not only will there be more and more big-hole jobs, but the sizes of holes doubtlessly will increase rapidly. Whereas a few years ago, "big-hole" meant perhaps 18- to 26-in. hole, it is apparent that holes of from 36- to 60-in. size are becoming commonplace.

What's the Future of Big-Hole Drilling? Rotary Equipment Undergoing Change. H. G. Bentson. *World Oil 151,* 110 (1960) Oct. (2 pp.)

Increasing success with which extra large-diameter holes (36-in. and larger) have been drilled in the last two years by rotary methods has resulted in the availability of a variety of new or modernized drilling bits and related equipment. Currently, there are several types of drilling bits available. Construction of these tools varies considerably, although most utilize rotating type cutters which are similar in principle and comparable in performance to those used on standard types of large rotary rock bits. Among the most widely used drilling tools are those commonly referred to as reaming bits or hole openers and cluster or plate-type bits.

Drilling Muds

Mud Mixing Idea Saves $20,000 Per Rig. J. E. Kastrop. *Drilling and Producing 32,* B-28 (1960) Sept. (5 pp.)

Fast mud mixing in relatively large volumes, casing and hole fillup, and mud tank stirring are some of the chores efficiently handled by a recently developed dual, independently-driven centrifugal pump hookup. In the past 2½ years, nine rigs in one company were equipped with these low-pressure high-volume units at a saving over conventional mud mixing hookups of some $20,000/installation. Each unit is simple in design, lighter in weight, easy to rig up, tear down, transport, and operates independently of the rig drive or rig-pumps.

Exploration

Here's How Oil Hunters Use the Stomper as a Seismic Tool. C. L. Kimbell. *Oil Gas J. 58,* 154 (1960) Sept. 19 (5 pp.)

Author describes technique, equipment and advantages of weight-dropping method in oil exploration. Field equipment as used today consists of a weight of from 6000 to 11,000 lb mounted on a vehicle. A drop height of 8 to 9 ft is used. The weight may be raised, location changed, and dropped approximately once every 12 sec. A large base area provides the most efficient coupling of energy into the ground. Seismic energy from a single drop normally is equal to that produced by 4 to 8 lb of dynamite.

Las Animas Arch—Promising Oil and Gas Frontier. J. A. Kornfeld. *World Oil 151,* 87 (1960) Sept. (4 pp.)

On the threshold of significant discoveries, the Las Animas Arch of eastern Colorado and western Kansas offers excellent oil and gas potential along a 250-mile front extending from New Mexico to Nebraska. Comprehensive review of significant new discoveries in the area, an authoritative geologic appraisal, plus four informative maps and cross sections, are given.

Locations for Tomorrow's Rigs. *Drilling 21,* 96 (1960) Sept. (2 pp.)

While the U. S. has been explored and developed more intensively than any other area on earth, there are enormous new, unexplored basins of great promise. These in Nevada, Utah and Arizona are among those discussed: the Great Basin, Permo-Triassic Basin, Paleozoic Basin, Eocene Basin, Kanab Basin, Kaiparowits Basin and Black Mesa Basin.

Geophysics

Geophysical Data for Trade and Sale. P. B. Bike. *Oil Gas J. 58,* 269 (1960) Sept. 26 (4 pp.)

New exploration concept has been developed—the geophysical exchange service, or library. These seismic exchange centers have sprung up in the past few years and are providing a much-needed service. Article tells where they are and how they operate.

Radioactivity Applications

Radioactive Isotopes Trace Well Treatment Results. W. E. Johnson. *Petrol. Eng. 32,* B-40 (1960) Sept. (3 pp.)

Although the use of radioactive material to trace down-the-hole injection treatments is not new, this method continues to be improved and used more widely. The results of 72 tracer surveys in the general Illinois Basin area again confirms the potential and usefulness of this method.

Recycling

Performance of an Alternate Repressuring and Producing Project. G. E. Crosby and R. J. Cochran. *J. Petrol. Tech. 12,* 39 (1960) Sept. (3 pp.)

Project of alternately repressuring and producing the reservoir described is an economic success. To begin the project it was necessary to repair casing leaks, recomplete one well, and to convert another well to an injection well, which cost $5862. The cost of compressing the gas, which was used for injection, was assumed to be $0.05/MCF. Average lifting cost, including overhead and taxes in the Texas area, is $0.71/bbl. The economics are summarized in tabular form.

Small Gas Repressuring Project Is Paying Off. P. R. Waddle. *World Oil 151,* 96 (1960) Sept. (2 pp.)

Gas injection into a single input well in Louisiana's 520-acre Rodessa field lease has resulted in an increased recovery of 1.2 million bbl of oil from the 12 producing wells. It is estimated that 58% of the anticipated ultimate recovery of 2.6 million bbl will be due to the repressuring program. All production in the area has resulted from gas injection since 1946.

Reservoir Engineering

How to Find Interstitial-Water Saturation from Electric Log Data. E. T. Guerrero and F. M. Stewart. *Oil Gas J. 58,* 113 (1960) Sept. 19 (2 pp.)

Data needed to find reserves and reservoir performance can be obtained by direct or indirect methods. The former involves measurement of the desired property on samples of the rock, fluid, or combined rock-fluid system. In the indirect method, a relationship between the desired property and a measurable secondary property is established.

Well Practice

High Pressure Completion. W. D. Smith, Jr. *Drilling 21,* 62 (1960) Oct. (3 pp.)

Well completion in the face of 8700 to 13,000 psi bottom hole pressures requires exacting techniques. As a matter of policy, Union Texas Natural Gas Corp. now uses a 1¼-in. tubing string or concentric tubing completion on all wells where a closed in surface tubing pressure of 6000 lb or more is expected. The 7-in. casing previously set inside a 9⅝-in. casing is pulled and replaced with a new P-110 casing. For completion, 4½- or 5-in. liner is cemented through the productive sands into a 7-in. liner. After conditioning the drilling mud, a 2⅞-in. tubing string is run and set on a production packer approximately 30 ft above the top of the perforations. After setting the 2⅞-in. tubing, the 1¼-in. tubing which has been hydrostatically tested is magnifluxed on the ends and run to a depth of from 7500 to 8500 ft.

Modern Well Completion Series. Part 8B. Formation Testing Fundamentals. C. R. Richardson. *Drilling and Producing 32,* B-64 (1960) Sept. (5 pp.)

Formation tests may be divided into two classifications: those conducted in open hole before casing is set, and those conducted in cased hole to test through perforations or to test a short section of open hole below the casing seat. Formation tests may be further divided into regular tests (testing a zone below a packer) and straddle tests (testing a zone isolated between two packers). Author discusses open hole tests, casing formation tests, formation pressures and recently developed techniques.

The Tubing String: Growing Factor in Deep Well Design. W. J. Safford. *Drilling 21,* 65 (1960) Oct. (3 pp.)

In many wells today, designing tubing strings is not a simple function of tension, collapse and burst type of available API tubes. Corrosion has been an oilfield problem almost from the beginning of the industry. Field pressures and new techniques, such as commercially developing the rotary piercer to produce the new commonplace seamless tube steels with 70,000 psi tensile and 40,000 psi yield strengths, and now much higher, have a long history. Wells over four miles deep have added a whole new list of words to the oilfield vocabulary, particularly when referring to tubing such as stress corrosion cracking, hydrogen embrittlement, and many others.

Tubingless Completions: A Review of Equipment, Economics and Techniques. J. F. Muse. *J. Petrol. Tech. 12,* 13 (1960) Sept. (7 pp.)

Economic advantages in completions utilizing 2⅞-in. tubing as casing are, generally speaking, quite obvious. In today's atmosphere of rising costs and increased competition, this completion method is being viewed with interest by practically every operating company. The number of completions made has increased greatly in the past year. It will increase even more when companies not now experienced with this type of completion are made aware of the methods successfully being utilized and the equipment being made available. In a rapidly developing technological change such as this, periodic reports are necessary to keep the industry advised of the progress made. Paper attempts to report the latest equipment, how it is being utilized, and what problem areas are evident.

Well Heads. J. M. Lebeaux. *Drilling 21,* 58 (1960) Oct. (5 pp.)

Modern wellhead equipment is described, including: casing or bradenhead; casing spool; casing hangers; tubing head; tubing hangers; and the Christmas tree.

4. GAS CONDITIONING AND LPG RECOVERY

Dust Removal

Apparatus for Sonic Treatment of Gases and Fluidized Beds. W. E. Coleman and T. F. Reed (assigned to U.S. Steel Corp.) U.S. 2,949,166 (1960) Aug. 16.

Apparatus is claimed for sonic treatment of dust-laden gases in which fine particles (aerosols) are agglomerated to a size readily removable by cyclones. An electromagnetic transducer is mounted at the top of a vertical cylindrical treating vessel and transmits a sound wave front downward through the rising dusty gas. A microphone mounted on the bottom sidewall picks up the sound, filters it to a narrow frequency band of 500-2500 cycles, and amplifies this by voltage circuits to recycle the current to drive the top transducer and to maintain a resonant wave loop in the system at the 160-decibel level.

Gas Washing Apparatus. E. Umbricht, G. Steenhagen and D. M. Evans (assigned to Ajem Laboratories, Inc.) U. S. 2,949,285 (1960) Aug. 16.

Gas washing apparatus for dust removal is claimed, which comprises a cylindrical tower with a foul gas inlet near the base, rotary centrifugal solution spraying device mounted with a pump on a central shaft, and baffles above to retain liquid from the cleaned air. The downward draining fouled solution is directed by a sloped bottom to a side trough which is liquid-sealed. A sloped rotary disc screen-filters the dirt-laden solution from this side trough, permitting the solids-free liquid to return to the feed sump below the pump. The disc-screen revolves upward and the outward slope permits the accumulated solids to be flushed off the screen into a separate dirt pocket or disposal system.

Gas Hydrates

Solving Gas-Hydrate Problems. L. E. Connealy. *Oil Gas J. 58,* 116 (1960) Oct. 3 (3 pp.)

Article gives some of the history of gas hydrates and the operation of Texas Eastern's wet-gas system. Special consideration is given to the use of methanol injection but other types of hydrate prevention are discussed.

Hydrocarbon Recovery

Packaged Unit Recovers Liquids from Low-Pressure Gas. *Petrol. Eng. 32,* B-96 (1960) Sept.

Three skid-mounted packaged sections, small enough that all three can be carried on an ordinary truck bed, make up the component parts of a new idea in liquid hydrocarbon extraction for field use. Unit was installed at the Fairview Roseland Station in Concordia Parish, La., for the Ingersoll Corp. The first installation is handling about 500,000 CF of casing-head gas/day at a line pressure of 100 psi.

Refrigeration Boosts LPG Recovery. *Chem. Eng. 67,* 96 (1960) Sept. 19 (3 pp.)

Recovery of propane, butane and higher hydrocarbons from sweetened natural gas that contains about 0.44 gal of propane and a mere 0.35 gal of butane and higher hydrocarbons/1000 SCF is a complicated problem. In the case of the natural gas in the Lacq area, France, this problem was further heightened by the gas being supplied at 100 psi. Solution is specially designed heat exchangers and cascade cooling systems to improve selective condensation of hydrocarbons from lean natural gas.

Texas Eastern's Rayne Field Gas Processing Plant Goes On-Stream. E. Sterrett. *Gas 36,* 154 (1960) Oct. (4 pp.)

In mid-1959, Texas Eastern Transmission (TET) bought the leasehold rights in the deep gas field near Rayne, La., with an estimated reserve of over 1 trillion CF. Producing from four sands, with a number of others proven but not now being produced, wells in the field average in depth from 13,500 to 14,000 ft. The gas is wet. But prior to completion of the Rayne processing plant, it was fed into the company's pipelines after customary separation. Design capacity of plant constructed to recover additional hydrocarbon liquids is 176 MMCF/day of residue gas. Design recoveries at a residue gas volume of 155 MMCF/day are 75% propane, 95% butane and 100% for heavier hydrocarbons.

Hydrogen Sulfide Removal

Cost of Removing Acid Gases. W. L. Nelson. *Oil Gas J. 58,* 136 (1960) Sept. 12 (2 pp.)

Labor, investment, maintenance and power costs are substantially the same for all processes. However, note that sometimes the gas plant in refineries is operated along with another process unit and thus the cost of operating labor may be half (or less) than the values quoted in the table in article. The cost of chemicals is not great for the regenerative type processes.

Removing Hydrogen Sulfide by Hot Potassium Carbonate Absorption. J. H. Field, G. E. Johnson, H. E. Benson and J. S. Tosh. *U.S. Bur. Mines Rep. Invest. 5660,* (1960) 19 pp.

Results of studies on a pilot-plant scale for removing hydrogen sulfide and carbonyl sulfide from gas mixtures by the hot carbonate system are given. Gases containing up to 10% hydrogen sulfide and 48 grains carbonyl sulfide/100CF were treated. In most tests, carbon dioxide also was present and was removed simultaneously with the sulfur compounds. Because the rate of absorption of hydrogen sulfide is much more rapid than that of carbon dioxide over a wide temperature range, selective removal of hydrogen sulfide occurred in the bottom section of the absorber near the point of gas entry. Hydrogen sulfide was removed to pipeline specifications with carbonate solutions by using split-stream flows in the absorber and regenerator.

Process for Maintaining High Level of Activity for Supported Manganese Oxide Acceptors for Hydrogen Sulfide. J. D. Batchelor, G. P. Curran and E. Gorin (assigned to Consolidation Coal Co.) U.S. 2,950,230 (1960) Aug. 23.

Process is claimed for removal of hydrogen sulfide from coarse carbonized carbon fuels by means of a manganese oxide catalyst coated upon powdered alumina or silica. This catalyst acts about 1100°F in a hydrogen fluidized bed to remove any H_2S formed from sulfur in the carbon. Loss of H_2S-absorbing activity by the manganese oxide acceptor is prevented by treating a portion of the manganese sulfate, reheating to 1300°-1600°F with O_2 to remove all sulfur as SO_2 and recombining with the remaining portion of MnO for repeated cycling through the sulfiding and oxidizing stages.

Method for Maintaining High Level of Activity for Supported Manganese Oxide Acceptors for Hydrogen Sulfide. J. D. Batchelor, G. P. Curran and E. Gorin (assigned to Consolidation Coal Co.) U.S. 2,950,229 (1960) sulfided material at 800°-1100°F with oxygen to form Aug. 23.

Similar process for reactivating the sulfided manganese acceptor (see U. S. 2,950,230) is claimed, in which the portion which has been converted to manganese sulfate is reheated with oxygen to 1300°-1600°F to drive out the remaining sulfur and convert to higher oxides of manganese. The oxidized material is then recombined with the remaining portion of the reheated acceptor for recycling.

Sweet-Gas Process Makes U.S. Debut. *Chem. Eng. 67,* 166 (1960) Sept. 19 (4 pp.)

Transwestern's new Giammarco-Vetrocoke plant is in the Puckett (Tex.) gas field, where one branch of the firm's new line begins. The installation is the largest of the 20-odd G-V plants throughout the world. It can sweeten 180 MMSCF/day of Puckett field output before the gas enters the line, reducing CO_2 content from 28% to under 2% and removing essentially all of the gas's 0.2% H_2S. G-V process removes CO_2 and H_2S from gas by treating it with potassium or sodium carbonate solutions activated by salts of multivalent metals (such as arsenic) or by undisclosed organic compounds. Solutions are regenerated by blowing with air or steam.

Sulfur Removal

Sulphur Extraction from Spent Oxide by Solvents. G. J. Middleton. *Gas J. 303,* 396 (1960) Sept. 14 (3 pp.)

Introduction of the Gastechnik process and the concentration of gas manufacture have tended to renew interest in the recovery of sulfur in the elemental state from spent oxide. Recovery of solid sulfur from spent oxide has been practiced in England and on the Continent for several decades, but the relative quantity of oxide so treated today in England is very small. The economics of gas purification with spent oxide are considerably influenced by oxide costs, not the least of which is the disposal of spent oxide. Article reviews the available solvent processes and indicates their potential application to the gas industry as now constituted.

5. NATURAL GAS TRANSMISSION

Automation

Remote Control Is Feature of Gas-Turbine Compressor Station. R. O. Parker, Jr. *Oil Gas J. 58,* 200 (1960) Oct. 10 (4 pp.)

As a system is expanded, installation and operating costs go down and reliability goes up if remote control is worked into the system, says author. Tennessee Gas Pipeline Co. found this to be so when it installed a master station to go along with an existing gas-turbine compressor station. Based on experience gained in this and other operations throughout its system, the company is going ahead with a computer-controlled station. It will be in operation next year.

Texas Eastern Installs Remote-Controlled Engine-Driven Station on Little Big Inch. C. H. Craft and A. Reine. *Oil Gas J. 58,* 236 (1960) Oct. 10 (2 pp.)

Early in 1960, Texas Eastern Transmission's Little Big Inch division increased the throughput of its 14-in. products pipeline lateral from Seymour, Ind., to Chicago by installation of a remote-controlled automatic booster station. Located near Lafayette, Ind., the approximate midpoint of the 233-mile line, this booster increased the design rate from 45,000 bbl/day to 65,000 bbl/day.

Compressors

Ark-La Gas Completes Four Years Operation with Non-Lubricated Compressors. P. J. Chandler. *Pipe Line Ind. 13,* 41 (1960) Sept. (3 pp.)

With more than 100 compressor cylinders now operating without lubrication, Arkansas Louisiana Gas has proved that molybdenum disulfide impregnated rings and packing run cooler and with less wear. Lubrication costs and chores have been reduced at main-line stations, on booster units and wet field gas compressors. Recent inspection of 1400-hp UTC compressor with 20,439 hr of nonlubricated operation showed wear of only 0.003-0.006 in.

El Paso Adds an Electric Motor Drive for a Centrifugal Compressor. J. R. Hoffman. *Gas 36,* 164 (1960) Oct. (6 pp.)

Author cites reasons for El Paso's decision to use an electric-motor driven centrifugal compressor when the company added another compressor station near Seligman, Ariz. Operation of station is described.

Similarity in Gas Compression of Radial Compressors in Case of Different Adiabatic Exponents. J. Sentek. *Ost. Ingenieur Z. 2,* 226 (1959) June (6 pp. German text.) (From *Appl. Mech. Rev. 13,* 675 (1960) Sept.)

Author develops similarity conditions for the compression of gases of different adiabatic exponents. The method is based on the assumption of polytropic compressions and the negligible effects of changes in (high) Reynolds numbers. It applies to uncooled turbocompressors. The method permits testing with air instead of design gases, modification of existing designs for other gases and model testing. E. J. McBride, USA

2-Cycle-Centrifugal Combination in Action. *Gas 36,* 160 (1960) Oct. (2 pp.)

Gas industry's first combination of a two-cycle, V-type gas engine driving a centrifugal pipeline compressor went into operation at the Hampshire, Tenn., station of Columbia Gulf Transmission Co.'s new automated pipeline in late August. Main elements of the installation are a two-cycle, turbocharged, V-type gas engine rated at 4000 boiler hp; a 24-in. by 24-in. centrifugal compressor; and a speed-increasing gear of lock-train design.

Fluid Flow

Pre-Calculation Method Determines Gas Volumes. F. W. Mayr. *Gas 36,* 110 (1960) Oct. (2 pp.)

Precalculations in tabular form have reduced errors and time consumed in Con Edison's calculations of gas drawn every 24 hours from pipelines. New method simplified clerical and arithmetic work involved in calculations for each orifice meter. Two series of precalculated tables are used. One gives values for combined factors normally experienced. This product is then located in a second series of tables called the integrator multiplier. This provides the calculator with a precalculated product of the combined factors and the constant (K). The integrator multiplier is multiplied by the integrator difference to give the volume in MCF.

Metering

Momentum-Change Mass Flowmeter Is Practical and Accurate. G. L. Farrar. *Oil Gas J. 58,* 90 (1960) Oct. 3 (5 pp.)

Test installations by nine oil and gas companies verify the dependability of the meter under a variety of field conditions in the measurement of gas. Simplicity of method and of meter make this technique attractive.

Pipeline Construction

One Solution to a Scouring River. *Pipe Line Ind. 13,* 44 (1960) Sept. (2 pp.)

To handle this foe of all underwater crossings, divers located the scours, and pipeliners packed burlap bags of sand-cement mix under and around the pipe to form a triangular wall across the scoured out section. All told, Natural Gas Pipe Line Co. pipeliners placed 17,615 bags in five scours at the eight line crossings of the Mississippi River near Muscatine, Iowa.

What Are Future Pipeline Needs? A. G. Barkow. *Oil Gas J. 58,* 211 (1960) Oct. 10 (8 pp.)

Summary of future pipeline needs, according to author, are: improved weldability; high-strength steels for large-diameter, thin-wall pipe, without loss in ductility; lower transition temperature and elimination of cleavage-type ruptures; notch insensitivity; better control of chemical and physical composition; pipe of closer tolerances; improvement of visual inspection in the pipe mill, at the unloading sites and in the field; and correlations of field experiences with laboratory and mill tests.

Work on Gas Lines to Import Gas to West Coast Will Start Soon. *Pipe Line News 32,* 18 (1960) Sept. (2 pp.)

Final approval for the largest single integrated natural gas line system in the history of the industry came through in August. Gas will initially be purchased by Alberta and Southern from producers in Alberta fields, then transported to the Alberta-British Columbia border by the Alberta Gas Trunk Line Co. Ltd. It will be transported across British Columbia to the U. S. border by Alberta Natural Gas Co. for delivery to Pacific Gas Transmission. The latter company will purchase the gas near Kingsgate, B. C. and transport it to the California-Oregon border for delivery to Pacific Gas & Electric Co. The California Public Utilities Commission approval August 16th was for the 300-mile segment of the system from Antioch, near San Francisco, to the northern border.

Pipeline Operations

Ball-Type Pipeline Devices. B. Ver Nooy (assigned to T. D. Williamson, Inc.) U.S. 2,951,255 (1960) Sept. 6.

Traveling ball for separating batches or scraping a pipeline is claimed. This comprises a flexible outer ball (of diameter to closely fit the line) within which is contained one or more relatively rigid gas-filled balls. The space between the balls is filled with liquid. The whole device is thus incompressible, and is lightened so that wear on the outer ball is reduced.

How Good Are Pipeline Control Systems? H. A. Brainerd. *Oil Gas J. 58*, 164 (1960) Oct. 10 (14 pp.)

Series of tests performed by Sinclair Pipe Line Co. in cooperation with seven major instrument companies show that much improvement is needed and outline areas where most of the work should be done. The nine elaborate, detailed tests also enabled Sinclair to determine the nine essential characteristics of a good pipeline control system.

Telemetering

Automation Gives Better Control of Measuring Stations. D. T. Casaday. *Gas 36*, 92 (1960) Oct. (7 pp.)

In an effort to improve its system, New York State Natural Gas Corp. installed an analog telemetering system equipped with automatic and supervisory control. Two measuring stations have been automated: the Petersburg (Ohio) station and the Coxcomb (New Kensington, Pa.) station. Operation of these stations and their relation to the over-all operation are discussed.

6. GAS AND LPG STORAGE

Methane Liquefaction

Internal Insulation Structure for Use with Liquefied Petroleum Products. F. A. Clauson (assigned to Texaco, Inc.) U.S. 2,947,438 (1960) Aug. 2.

Internal insulation structure is claimed for storage tanks for low-temperature, low-pressure liquids. The structure consists of box-like panels formed of top and bottom rings of sheet metal welded horizontally to the inner tank wall and arranged to slope downward. The inner face of the box panel is welded to the inner downward sloping edges of the rings, with several apertures provided along the lower ring to allow liquid and vapor to enter the box. The box panels are superimposed to line the entire tank wall and are filled with porous or foamed solid insulating bats. The vapor tends to fill the box freespace and by its pressure permits only minimum entry of the liquid, thus providing a gaseous insulating barrier.

Storage

Storage Tanks for Liquids. D. M. Greer. U.S. 2,947,437 (1960) Aug. 2.

Storage tank for liquids lighter than water is claimed which is designed to keep the container partly immersed. A vertical cylindrical shell of thin sheet metal or plastic is supported in a shallow excavation by a flange ring secured at intermediate wall height, said ring resting on the tops of vertical piles spaced circumferentially. This ring resists hydrostatic pressure of stored oil. Oil is retained by a flexible foldable bag or a diaphragm structure of bellows type, which rises and falls with hydrostatic height of stored oil.

Underground Storage

Aquifers for Underground Natural Gas Storage. Part 5. Water Well Stimulation, Performance Evaluation, Tracers. *Am. Gas J. 187*, 31 (1960) Sept. (5 pp.)

Concluding article in the series on use of aquifers for storage analyzes performance data for various types of stimulation of water wells, and use of tracers in remedial operations. Comprehensive bibliography includes references on drilling and completion; hydrology; reservoir performance; well stimulation; and ground-water tracers.

Detection of Water or Other Materials in the Effluent from an Underground Storage Cavern. R. E. Wrightman (assigned to Phillips Petrol. Co.) U.S. 2,950,601 (1960) Aug. 30.

Improved control is claimed in pumping stored liquids from underground caverns, in which a dielectric probe in the outlet pumpline is connected by leads to a capacitance controller. This controller is set to shut-off the motor valve in the displacement water inlet at above a certain capacitance value.

Terra Alta. The Story of a Storage Field, a Compressor Station, and a Pipeline. W. T. Harper. *Gas 36*, 141 (1960) Oct. (13 pp.)

Description of Atlantic Seaboard Corp.'s three-phase X-76 project which links a storage reservoir near Terra Alta, W. Va., to the company's Seneca compressor station about 45 miles due north. Project consisted of reconditioning the old wells in the storage field and laying the network of gathering lines from the wellheads into a mainline; construction of a compressor station near Terra Alta; and construction of a mainline running from it to the Seneca station. Field at Terra Alta contained 41 wells, 21 of which were reconditioned for injection and withdrawal. Comprehensive article carries story from storage through the compressor station and on in to Atlantic's mainline to its major market-area customers.

7. MANUFACTURED GAS AND CHEMICAL PROCESSING

Aromatics

Benzole Refining: A Review from 65's to '60. Thornton Scott. *Gas World 152*, 37 (1960) Sept. 3 (12 pp.)

Progress in the art of benzole refining during several years is reviewed and the most important changes and advances are stressed. Attention is drawn to factors that have induced these changes, to the resultant changes in the technique of laboratory methods, and to the effect of the growing importance of benzole on the outlook of management and the quality of technical staff. Some factors of significance to benzole refiners are discussed.

Continuous Benzole Refining at Appleby-Frodingham Steel Company. R. C. Dooley. *Coke and Gas 22*, 403 (1960) Sept. (7 pp.)

New refining plant described is the first distillation plant in England to produce high purity benzene, toluene, xylene and naphtha products continuously from coke-oven crude benzole. The raw crude is first treated in the new patented APV "Defronting" Unit. This unit effects a very sharp separation of benzole "fronts" (of which

carbon disulfide and cyclopentadiene are major constituents) and facilitates the later separation of pure products and improves their washing characteristics.

Carbon Monoxide

Purifying Hydrogen by Selective Oxidation of Carbon Monoxide. M. L. Brown, A. W. Green, G. Cohn and H. C. Andersen. *Ind. Eng. Chem. 52,* 841 (1960) Oct. (4 pp.)

Hydrogen containing less than 10 ppm of carbon monoxide is required for several processes, especially ammonia synthesis. An attractive method of achieving such purity is to convert the carbon monoxide selectively to carbon dioxide with added air. Catalyst effluent gas contains less than 10 ppm of either carbon monoxide or oxygen. Platinum, ruthenium, and rhodium are effective catalysts, particularly supported platinum, which removed carbon monoxide with the least oxygen. For reformed gas, 2% carbon monoxide could be reduced, in carbon dioxide-free streams, to 10 ppm or less. Temperature must be held within the selective zone (250° to 320°F) by steam dilution. By applying the results to a two-stage purification system, process advantages and economies in ammonia-synthesis gas plants are predicted.

Carbonization

Pilot Plant Studies on the Production of Soft Coke by a Travelling-Grate Stoker Carbonizer. S. G. Rao, M. K. Mookherjee, M. D. Das Gupta, S. K. Das Gupta and A. Lahiri. *J. Sci. & Ind. Research 19A (General),* 26 (1960) Jan. (6 pp.)

Possibilities of preparing soft coke for domestic heating purposes in a moving bed carbonizer with a traveling grate for conveying sized coal into the heated zone of a built-in furnace, developed at the Central Fuel Research Institute (India), are discussed. The principle involved is to devolatilize the coal to the required degree by the heat of combustion of the volatiles generated by passing a restricted quantity of air from below the grate. Technique is superior to the stack burning process in a number of respects.

Catalysts

The Activity of Raney Nickel as a Function of Hydrogen Content. R. J. Kokes and P. H. Emmett. *J. Am. Chem. Soc. 82,* 4497 (1960) Sept. 5 (5 pp.)

Surface area of Raney nickel and its activity for ethylene hydrogenation and parahydrogen conversion were studied as a function of hydrogen content. These data were interpreted on the assumption that Raney nickel is a substitutional solid solution of nickel, aluminum and hydrogen promoted with alumina. It was tentatively concluded on the basis of comparison of these results with those reported for the copper-nickel system that the number of valence electrons per unit cell added by dissolved hydrogen, copper or other alloying components is an important consideration in comparison of such alloy systems. The activity of nickel at first decreases and then increases with an increase in the number of added electrons per unit cell.

The Chemisorption of Oxygen on Nickel. R. J. Leak and P. W. Selwood. *J. Phys. Chem. 64,* 1114 (1960) Sept. (7 pp.)

Chemisorption of oxygen on nickel-silica catalyst systems has been investigated by the low-frequency a.c. permeameter method and volumetric gas adsorption techniques. The nickel particles were in the superparamagnetic range or slightly larger. A method has been developed for distinguishing between true chemisorption of oxygen on nickel as contrasted with surface oxide formation; it employs a change in magnetic anistrophy energy in particles of nickel in the 100 A diameter range. An explanation is discussed for the so-called "hydride anomaly" in the chemisorption of hydrogen on nickel at low temperatures.

The Effects of Oxygen Adsorption on the K X-Ray Adsorption Edge of Alumina Supported Nickel. P. H. Lewis. *J. Phys. Chem. 64,* 1103 (1960) Sept. (7 pp.)

New analytical technique is applied to show differences in the nickel K X-ray adsorption edge due to oxygen chemisorption on small (30 A) nickel crystals in an alumina support catalyst. These changes show that the nickel-oxygen bond formed on the nickel surface is similar to that in bulk nickel oxide. The experimental data are interpreted as showing that the chemisorbed oxygen reduces the p character of the nickel's 4s band and increases that of the 4p band.

Coal

Coal and Science. *Gas World 152,* 397 (1960) Sept. 17 (5 pp.)

In March, 1960, a study conference was organized by the National Union of Mineworkers (Great Britain) to discuss freely and impartially the problems of the coal industry. Article abstracts the paper (and ensuing discussion) given by D. T. A. Townsend, director-general, BCURA. Paper deals with present position of the scientific understanding of coal as a material and with some current aspects of coal utilization. Abstracts of the discussion are particularly concerned with gasification.

The Relationships of the Properties of Coals with Those of Their Cokes. N. C. Sinha, B. K. Sinha, A. K. Roy Chowdhury, J. N. Sanyal, N. N. Das Gupta and A. Lahiri. *Coke and Gas 22,* 382 (1960) Sept. (7 pp.)

From present studies, it is seen that coking index values of coals arbitrarily calculated from their elementary composition and calorific value and the inert constituents of coals determined by an empirical method have significant correlation with the heat of wetting and volatile matter of coals. In earlier studies, the latter properties of coals were observed to be closely related to the physical properties of coke. As can be expected by analogy, these newly determined coking index and inert constituent values also bear close correlation with the quality of cokes. No relationship could, however, be traced between the plastic and swelling properties of coals and the properties of their cokes. This is contrary to the finds of other workers on Scottish coals.

Coal Hydrogasification

Gasification of Brown Coal with Hydrogen in a Continuous Fluidized-bed Reactor. T. J. Birch *et al. J. Inst. Fuel 33*, 422 (1960) Sept. (15 pp.)

Gasification of Yallourn brown coal with hydrogen in a continuously operated co-current fluidized-bed reactor has been investigated. The bed of the reactor was 3 in. in diameter and 3 ft deep. The influence of variables such as temperature (500°-950°C), total pressure (300-600 psi), hydrogen partial pressure (0-550 psi), coal feed rate (5-36 lb/hr) and the composition of the hydrogenating gas was studied. The results show that hydrogenation of the coal occurs in two fairly well defined stages. The first stage, which removes oxygen groups and hydrocarbon side chains, is very rapid and competes with pyrolysis reactions. The second stage, in which the residual condensed carbon structure is hydrogenated, involves a much slower reaction. The influence of temperature and hydrogen partial pressure on the rate of this reaction is discussed.

Ethylene

Absolute Rate Measurements of O-Atom Reactions with Ethylene and with Butane. L. Elias and H. I. Schiff. *Can. J. Chem. 38*, 1657 (1960) Sept. (9 pp.)

Absolute rate constants for the primary reactions of O-atoms with ethylene and with butane have been determined in a fast-flow system. The O-atoms were produced by electrodeless discharge of O_2 and allowed to react with the hydrocarbon introduced downstream. Addition of a small amount of NO to the gas stream enabled a photometric monitoring of the O-atoms in the reaction zone. The initial atom concentration was determined by NO_2 titration. The reaction could be stopped at any point in the reaction zone by means of a movable surface of cobalt oxide. The hydrocarbon concentration at any point could then be determined by condensation downstream and analysis of the products. Rate measurements were carried out over the range −50° to 200°C. The rates were found to be consistent with a two-body mechanism.

Hydrogen

Hydrogen Permeation Through Metals, Alloys and Oxides at Elevated Temperatures. C. L. Huffine and J. M. Williams. *Corrosion 16*, 430t (1960) Sept. (3 pp.)

Permeation rates of hydrogen through AISI Type 446 stainless steel and an iron-chromium-aluminum alloy (20% Cr, 5% Al, balance Fe) were determined to 2150°F under various conditions of surface oxidation. The presence of a continuous oxide film resulted in a thousand fold reduction in permeation rate over that through the unoxidized metal at elevated temperatures. Under conditions in which the oxide could not be replenished, its barrier effect was largely destroyed through reduction of the oxide by the emerging hydrogen.

Purer Hydrogen at Reasonable Cost. *Petrol. Week 11*, 88 (1960) Sept. 23 (2 pp.)

Next development in refining: the upgrading of recycle gas to obtain purer hydrogen. This purer hydrogen can be obtained economically by cryogenic-low temperature-separation methods. Among leading companies engaged in the field of cryogenics are now offering refiners installations for the low temperature upgrading of hydrogen-rich recycle gas are Linde Co., Division of Union Carbide Corp., Air Products Corps., and, foreign, American Air Liquide, Inc., of France, American Messer Corp., of Germany and the German Linde Co.

Lignite

Problems and Techniques of the Distillation and of the Gasification of Lignite. G. Mozzi. *Rivista dei Combustibili 14*, 521 (1960) July-August (21 pp. Italian text.)

Present-day techniques for lignite's exploitation, by its transformation in more valuable fuels, are well advanced. Problem of lignite's transformation to gas or coke is no more a technical, but only an economical, one. Its solution depends upon the characteristics and the entity of the coal bed. The technique of underground gasification has such disadvantages that it cannot be generally used. The possibilities of transforming the lignites through their hydrogeneration seem to be more favorable.

Mixed Gas

Possibilities of Natural Gas Addition in Expansion of Gas Supplies. E. Schumacher. *Gas u. Wasserfach 101*, 103 (1960) Sept. 9 (6 pp. German text.)

Development of the gas supply of Munich is discussed. The original output of coal (retort) gas and coke watergas required expansion, which was provided by 10% natural gas added in 1957 and now by cracked natural gas since October 1958. The cracking plant produces 8 MMCF/day of cracked gas from 3.1 MMCF/day of natural gas, for mixed city gas, which has been the most economical solution of a supply problem for one million population, rather than complete changeover to natural gas which would require large appliance conversion costs. A mixture of producer gas, coal gas, natural and cracked natural gas is now used (watergas is shut down) and a second cracking unit is under construction.

Ore Reduction

HyL Sponge Iron Production. J. Celada and G. H. Muller. *Chem. Eng. Progress 56*, 66 (1960) Sept. (5 pp.)

Better steel at minimum cost with currently available raw materials is now possible with the flexible HyL gaseous reduction process, say authors. Process derives its name from the Mexican manufacturing company, Hojalata y Lamina, S.A., who developed the process at their works in Monterrey, N.L. Units ranging in size from 100 to 2000 tons/day can be operated economically.

Iron Ore Reduction—Kinetics and Thermodynamics: I. *Ind. Heating 27*, 1876 (1960) Sept. (3 pp.)

Kinetics of a fluidized bed technique for direct reduction of finely ground iron ore and the various stages of the H-Iron process are discussed. Article comprises ab-

stracts of two of the five papers presented at the Iron Ore Reduction Session of the Blast Furnace, Coke Oven and Raw Materials Conference, sponsored by the AIME in April.

ORCARB Process Provides High Prereduction in Production of Pig Iron. *Ind. Heating 27,* 1800 (1960) Sept. (7 pp.)

In a pilot plant in Indianola, Pa., one corporation is developing a unique method for reducing iron ore directly into pig iron. Called the Orcarb process, three basic steps are involved: 1) preparation of agglomerates of ore, low-temperature coke and flux; 2) high degree of prereduction in a rotary kiln; and 3) smelting in an electric furnace. Advantages of the process are: 1) the capital cost is about half that of corresponding facilities using standard iron blast furnace; 2) production cost, operating and fixed charges are comparable to blast furnace process; 3) half the quantity of carbon from high volatile coal is required as compared to that needed by the blast furnace; 4) fine ores may be used without any sintering required; 5) production units are readily shut down and started up; 6) prereduction in kiln significantly reduces the KW requirement for electric furnace smelting; and 7) electric furnace smelting affords close metallurgical control of product.

Petroleum Refining

1960 Process Handbook. *Petrol. Refiner 39,* 175 (1960) Sept. (106 pp.)

Newest edition of the Handbook includes the eight new processes announced to the industry since the last publication two years ago. Other processes are added for the first time to give a comprehensive coverage of the current situation. All of the refining processes are classified and summarized into broad categories. To assure authoritative information, the process descriptions are presented by companies. Each process is described with application, charge, products, operating conditions, yields, economics and commercial installations.

Synthesis Gas

Production of Synthesis Gas. N. P. Peet (assigned to Esso Research and Eng. Co.) U.S. 2,946,754 (1960) July 26.

Improved process is claimed for production of synthesis gas from methane or natural gas. This consists of burning a portion of the feed gas in a furnace zone, cooling the flue gas with water to obtain steam and recovering CO_2 from cooled flue gas by known processes. The remaining (two-thirds) natural gas is mixed with one-third its volume of the recovered CO_2 and one-sixth volume of generated steam and passed at 0-300 psi and 1100-1850°F through a nickel-alumina-type catalyst. The catalyst coil is arranged in the furnace zone. A gas of two parts H_2 and one part CO is produced.

Reaction of Gaseous Hydrocarbons with Oxygen. E. Bartholme, H. Nonnenmacher and O. Frey (assigned to Badische Anilin- & Soda-Fabrik A.G.) U.S. 2,951,749 (1960) Sept. 6.

Process for producing synthesis gas from methane-containing gas is claimed. Separate streams of oxygen (less than stoichiometric) and gas are mixed with steam, each is preheated to 600°C, and the two are passed rapidly downward into a mixing zone. The zone expands into an empty conical zone to reduce gas velocity. The gas then continues (without flame) through an inert refractory (magnesite) layer of 10-20 mm granules and finally through a nickel-on-magnesite catalyst layer.

Underground Gasification

Underground Gasification of Coal. Hydraulic Fracturing as Method of Preparing a Coalbed. J. P. Capp, J. L. Elder, C. D. Pears, R. W. Lowe, K. D. Plants and M. H. Fies. *U.S. Bur. Mines Rep. Invest. 5666,* (1960) (50 pp.)

Experiment was conducted to investigate hydraulic fracturing as a means of increasing the air acceptance of a coal bed to permit introducing combustion air and removing product gases. Specific objectives of the investigation include: 1) fracturing a coal bed; 2) determining the distance the coal was physically affected; 3) ascertaining the effect of the fracture on air acceptance of the coal bed; and 4) gasifying the coal.

8. GAS DISTRIBUTION

Conversion

Hartford Gas Reports on the Intermediate Gas Method of Conversion. A. C. Dudley. *Gas 36,* 99 (1960) Oct. (4 pp.)

Article describes advantages of intermediate gas method used by Hartford Gas Co. over a seven-year period in converting its system from manufactured and mixed gas to natural gas. The intermediate gas method of conversion was selected because it was less expensive, required fewer men (although for a longer time), caused less customer inconvenience, involved less C.G.I. trouble and because no reversal of flow in mains would be encountered.

Distribution Systems

Distribution Regulator Station Design. E. A. Skibinski. *Gas 36,* 55 (1960) Sept. (6 pp.)

Author discusses regulator station design in terms of his own company, the Rochester Gas & Electric Corp. (N. Y.), which operates at three general pressure levels: high (125 psig maximum); medium (2-50 psig); and low (below 12-in. water column). Since 1952, every regulator vault in the Rochester system has been rebuilt to improved standards, meeting the requirements of the New York State Public Service Commission Rules and Regulations and of the ASA B31.8 code. New York rules and regulations are outlined, and schematic drawings depict the improved stations.

Leakage

Pipe Sealing Device. E. K. Ferguson and B. A. Kronmiller. U.S. 2,950,702 (1960) Aug. 30.

Leak sealing device for pipelines is claimed which consists of a pair of discs with inflatable rims to engage the bore of the line. The discs are mounted on a central pull-rod, with separation to form a chamber for the sealing fluid, with one disc movable to squeeze the fluid through leak points when drawn by cable through a line. The sealing fluid may be a magnesium aluminum silicate slurry which forms a silica gel upon flocculation in the crevices.

Pipeline Leak Surveying. H. J. En Dean, J. D. Jones and E. Topanelian, Jr. (assigned to Gulf Research & Development Co.) U.S. 2,951,362 (1960) Sept. 6.

Leak survey device for pipelines is claimed, in which a movable carriage with spaced pipe wall packing washers serves to isolate successive portions of the line. A pressure-registering unit carried by the device records the pressure drops when the isolated section passes a leakage point. Such pressure is transmitted by tubing from the space intermediate of the packers to one side of a diaphragm and from the pipeline outside the packers to the other side, with the moving diaphragm actuating the marking stylus.

Piping

Copper Tubing for Service Renewals. T. F. McCarthy. *Gas Age 126,* 36 (1960) Sept. 15 (2 pp.)

Because the greater Btu value of natural gas allows pipe size reduction, Elizabethtown Consolidated Gas Co. (Elizabeth, N. J.) installs a new 1-in. copper serviceline through the existing 1¼-in. steel pipe in the ground. It is necessary only to dig a small hole over the gas main in the street and work through the old serviceline to this hole from the front wall of the building. No trench is necessary; not only is considerable digging avoided, but costly repaving as well.

Glass-Reinforced Plastic Pipe. R. M. Levy. *Oil Gas J. 58,* 96 (1960) Sept. 19 (3 pp.)

These characteristics favor glass-reinforced plastic pipe: corrosion-resistant, high strength, lightweight, improved flow characteristics, resistance to paraffin deposition, low thermal and electrical conductivity, noncontamination of product, and ease and economy of installation.

Ohio Fuel Installs All-Plastic Distribution System. *Am. Gas J. 187,* 49 (1960) Sept. (2 pp.)

First use of plastic pipe on a community-wide scale for a natural gas system was made recently by the Ohio Fuel Gas Co. in extending service to the new market of North Robinson, Ohio. With the exception of the medium pressure supply line that brings gas to the community, the entire distribution system was constructed with an ABS-type plastic pipe—4940 ft of 2, 3 and 4-in. sizes. The $25,770 project made gas service available to 84 homes and stores plus a new school in the village. Engineers solved pipe detection problem by "wiring" the pipe.

Resin Patch Method Repairs Pipe in 30 Minutes Without Use of Flame. *Gas Age 126,* 50 (1960) Sept. 15 (2 pp.)

New method of pipe repair offers the advantages of thermosetting epoxy resins. It can be used on any diameter pipe operating at pressures up to 100 psi and can be applied without removing the line from service.

9. GAS FUEL UTILIZATION AND APPLIANCES

Air Conditioning

Gas "Climate Controls" a Giant Plant. *A.G.A. Monthly 42,* 23 (1960) Oct. (2 pp.)

Black & Decker Manufacturing Co., world's largest maker of electric tools, recently put into service a natural gas air conditioning unit at its headquarters plant in Towson, Md. A 12-cylinder natural gas engine, rated at 915 hp at 1100 rpm, furnished the power for the cooling plant. The large gas engine is the unusual component in the large compressor-type installation. A speed increaser, with a step-up ratio of approximately 8:1, is employed between the engine and a centrifugal compressor.

Preventive Maintenance Paves Way to Dependable Operation. *Heating, Piping and Air Conditioning 32,* 149 (1960) Oct. (12 pp.)

Need for maintaining heating, piping and air conditioning systems increases with their age, complexity and value. These systems lend themselves to the systematic approach of preventive maintenance. A way to establish a program of controlled preventive maintenance is outlined.

Air Pollution

Adsorbing Sulfur Dioxide on Dry Ion Exchange Resins for Reducing Air Pollution. R. Cole and H. L. Shulman. *Ind. Eng. Chem. 52,* 859 (1960) Oct. (2 pp.)

Many industrial waste gas streams contain materials which are recognized atmospheric contaminants. Development of technically and economically satisfactory processes for recovery or removal of these materials is of importance because of recent regulatory actions. Dry polymeric anion exchange resins adsorbed up to 50% of their own weight of sulfur dioxide from air-sulfur dioxide mixtures. Adsorption isotherms of dry IRA-400 (chloride form), silica gel, activated charcoal, and molecular sieve type 5-A at 25° and 100°C, show the IRA-400 resin to compare favorably with recognized adsorbents. Commercially available anion exchange resins are thus potentially useful for recovery of sulfur dioxide from waste gas streams.

Air Pollution by Formation of Sulfuric Acid in Fogs. H. F. Johnstone and A. J. Moll. *Ind. Eng. Chem. 52,* 861 (1960) Oct. (3 pp.)

Formation of sulfuric acid from sulfur dioxide in fog droplets containing dissolved oxidation catalysts is important in air pollution. Rates of acid formation were measured in fogs formed under controlled conditions in air containing nuclei and 4 to 500 ppm of SO_2, corresponding to concentrations in stack gases from the combustion of sulfur-bearing fuels after dilution 10 to 1000 times. In expansion fogs with manganese sulfate nuclei, concentrations of H_2SO_4 between 0.1 and 2 mg

per cubic meter were formed in less than 5 minutes, depending on the sulfur dioxide concentration and the time of exposure of the fog. Other manganese salts produced similar concentrations of acid. Fogs formed with ferrous sulfate nuclei and those with mixtures of manganese sulfate and sodium chloride as nuclei produced acid at slower rates than fogs with manganese sulfate nuclei only. The highest rate of acid formation was in fogs with manganese sulfate nuclei at relative humidities just below 100%. In these fogs the rate of acid formation was approximately proportional to the concentration of sulfur dioxide between 4 and 500 ppm.

Air Pollution in Hamilton, Ohio. P. A. Kenline. (The Robert A. Taft Sanitary Eng. Center Tech. Rep. A-60-8.) 1960, 20 pp.

At the request of the Hamilton City Health Department, the Public Health Service conducted an appraisal in Hamilton of factors relative to air pollution. The Ohio Department of Health and the Hamilton City Health Department assisted in the conduct of the study. The purpose of this appraisal was to determine the status of the air pollution situation and the need for activity on the part of the government in solving air pollution problems. This report is an analysis of data and information assembled on air pollution levels, sources, dispersion, and local control activity.

Method and Apparatus for Treating Exhaust Gases with an Exhaust Gas Burner with Catalytically Induced Flame. W. Clayton (assigned to Barkelew Manu. Co.) U.S. 2,947,600 (1960) Aug. 2.

Method and apparatus for treating auto exhaust gases to attain their complete combustion is claimed, in which catalytic oxidation is applied. The device consists of a cylindrical metal shell in which is supported centrally a front catalyst and a rear combustion chamber surrounding a central pilot-burner tube. The exothermic oxidation of a small portion of gases and air by the catalyst serves to preheat the central pilot tube, which carries a portion of hot exhaust gases to the rear combustion chamber to maintain a pilot flame, with controlled air supply. The main portion of exhaust gas passes through an annular outer space of shell to the rear combustion chamber where it is ignited by the pilot.

Burners

Industrial Gas Burner. R. E. Buckholdt (assigned to Selas Corp. of America.) U.S. 2,947,526 (1960) Aug. 2.

Improved industrial burner is claimed, comprising a burner block adapted to installation in a furnace wall, with a protected tubular conduit extending centrally through the block to support a hollow disc member. The block, with a conical depressed area behind the disc, provides a combustion chamber, fed by an annular portion of the central conduit. The disc provides a separate burner with peripheral flame ports, with a controlled combustion mixture fed centrally by the conduit, to give a flame-tempering and radiation-spreading effect.

Flame Research

Activation Energy and Reaction Order in Methane-Oxygen Flames. H. Vandenabeele, R. Corbeels and A. van Tiggelen. *Combustion and Flame 4*, 253 (1960) Sept. (8 pp.)

Flame propagation velocities and temperatures have been measured in preheated and unpreheated methane-oxygen mixtures at different mixture strengths and varying dilutions with nitrogen. An activation energy of 38 kcal can be derived from these measurements. The order of the reaction with respect to oxygen is 1.4 and with respect to methane, −0.4. These parameters (orders and activation energy) are ascribed to the branching process. The reaction mechanism is discussed.

The Formation of Polycyclic Aromatic Hydrocarbons and Carbon Deposits from Normal and Reversed Diffusion Flames. A. J. Lindsey. *Combustion and Flame 4*, 261 (1960) Sept. (4 pp.)

Polycyclic aromatic hydrocarbons have been determined in the carbonaceous deposits from normal and reversed diffusion flames of a number of pure gaseous and liquid hydrocarbons used as fuels. Many of these compounds have not previously been detected or determined in partial combustion products of the fuels used, and it has been demonstrated that they are always present in such deposits whatever fuels are used. It is suggested that they may originate from simple radicals such as CH which are known to be present in such flames, and that they may be precursors of the carbon with which they are always associated in the flame deposit.

Heterogeneous Combustion of Multicomponent Fuels. B. J. Wood, H. Wise and S. H. Inami. *Combustion and Flame 4*, 235 (1960) Sept. (8 pp.)

Variation of burning rate coefficient (the time-rate change of drop cross-sectional area) as a function of composition was determined for single drops of a group of binary fuel mixtures. The results indicate that during combustion the composition of a multi-component fuel drop changes by a process of simple batch distillation. Drops of fuel mixtures containing components of widely different boiling points demonstrated instability during combustion. Motion pictures of these burning drops reveal the formation of bubbles which expand and burst in the liquid phase. It is suggested that these effects are due to radiative heat transfer from the flame envelope to the liquid, resulting in local vaporization of the more volatile components within the drop.

Kinetic Parameters for the Hydrogen and Ethylene Flames from Flashback Measurements. B. Fine. *Combustion and Flame 4*, 243 (1960) Sept. (10 pp.)

Values for the flame activation energy and an over-all reaction order have been obtained for premixed hydrogen-oxygen and ethylene-oxygen flames with nitrogen and with argon as diluents; the values come from measurements of the change with pressure and flame temperature of the critical boundary velocity gradient for flashback. Measurements have been made for rich and stoichiometric hydrogen flames and for lean and stoi-

chiometric ethylene flames. For hydrogen flames with nitrogen diluent an over-all order of 2.3 is found; for ethylene flames with nitrogen diluent, the order obtained is 1.8. With argon diluent, values for the order are about 10 per cent lower for each flame. With nitrogen diluent the flame activation energy apparently increases with flame temperature; this increase is not found with argon diluent. For hydrocarbon flames the assumption that the initial equivalence ratio equals the effective equivalence ratio in the flame leads to an order of reaction with respect to oxygen that is considerably larger than unity. For hydrogen flames, that assumption is consistent with an oxygen order of unity.

Temperatures of Flames Burning on Porous Burners. D. B. Spalding and V. S. Yumlu. *Combustion and Flame 4*, 285 (1960) Sept. (4 pp.)

It does not appear possible to calculate the temperature of flames burning on porous burners from the Q values of Spalding and his coworkers, even if corrections are made for the heat losses known to occur. The burning velocity is a single-valued function of flame temperature, in contrast to its dependence on Q. In a private communication Dr. Spalding has indicated that he too believes that the burning velocity is a single-valued function of flame temperature, but that heat losses other than to the burner allow S_{20} to be a double-valued function of Q.

Heat Pump

Heat Pump Reclaim System Proves New Design Approach. N. Hill. *Heating, Piping and Air Conditioning 32*, 93 (1960) Sept. (10 pp.)

Two winter's successful operation, in one instance bucking temperatures as low as —7°F, attest to the excellent design of the heat pump system serving an Oklahoma City office building addition. The system, a mark of simplicity in engineering design, provides year round comfort to occupants via the heat pump reclaim cycle. Article explains the engineering reasoning behind the design and how all factors were considered, including weather statistics, land variations, control and ventilation requirements, and the economy of using the reclaim cycle.

Heat Treating

Steel Composition Adjusted During Open Coil Annealing Through Controlled Gas-Metal Reactions. *Ind. Heating 27*, 1864 (1960) Sept. (5 pp.)

New commercial method for changing and controlling the composition of steel is the direct outgrowth of the relatively new open coil annealing process. New method makes it feasible to remove or add carbon, nitrogen, and other alloying elements, that can be gasified, during the annealing of commercial-size coils of rolled steel.

Ignition

Ignition and Flame-Failure Equipment for High-Velocity Air-Blast Tunnel Burners. *Ind. Gas 23*, (Britain) 8 (1960) Sept. (2 pp.)

New high-velocity air-blast tunnel burner, developed at the Midlands Research Station of the Gas Council, calls for a special type of flame-failure and ignition control, and to meet this requirement the FST series of control units has been produced. Regarding control of ignition, this type of burner is supplied with gas and air in correct proportions to give complete combustion in the tunnel—providing a stoichiometric mixture. Ignition can very conveniently be achieved by a sparking plug positioned in the mixture tube behind the tunnel; arranged thus, ignition is smooth and immediate, and the flame travels forward and burns correctly within the tunnel.

Industrial Heating

Natural Gas Stabilization Control for Coke Oven Gas Replacement. J. L. Doss. *Gas 36*, 108 (1960) Oct. (2 pp.)

Carnegie Natural Gas Co. supplies a major portion of fuel required for several U. S. Steel Corp. plants in the Pittsburgh area. In the operation of the mills, demand for fuel often exceeds supply of coke oven gas. Natural gas, stabilized with air, is used to supplement the supply. The gas is supplied through a jet compressor system in the required amount to maintain the system pressure throughout the changing demand. The Btu of stabilized mixture is controlled by a Thermeter to assure constant interchangeability of gases.

How Town Gas Helps in Metal Finishing—2. *Ind. Gas 23*, (Britain) 11 (1960) Sept. (6 pp.)

Infrared heating has a wide field of application, essentials for its success being that the objects to be heated must have about the same surface-to-weight ratio, be capable of receiving the radiation over the major part of their surface, and have a sufficiently high conductivity to carry the heat to parts shielded from radiation. Among the applications discussed are lacquering, vitreous enamelling, galvanizing, metal spraying and plastic coatings.

Space Heating

Prefab Radiant Panels, Packaged Units Heat and Ventilate Six-Building Campus. R. Burgett. *Heating, Piping and Air Conditioning 32*, 121 (1960) Oct. (3 pp.)

Unique combination of prefabricated radiant panels and individual heat exchanger-air handling units—both supplied by the same central hot water source—heats and ventilates a brand new six-building junior high school campus in Cincinnati. The space-saving advantage of a central heating plant is enhanced by a design utilizing a 40°F temperature drop to permit smaller supply lines, suspended radiant panels which require no floor space, and the use of "waste" spaces above the lavoratory areas to house ventilation equipment.

Water Heater

Two-Temperature Water Heating System. E. D. Dennis (assigned to A. O. Smith Corp.) U.S. 2,948,277 (1960) Aug. 9.

Improvement is claimed in a system for providing heated water at two different temperatures. This consists of a primary system with a storage tank, circuit and gas-fired heater to maintain a lower water temperature of 140°F. A high-temperature water circuit for providing 180°F water for dishwashing, sanitizing, etc., is formed of a loop of small-diameter delivery piping to the appliance, the loop being bypassed by a control valve between the water heater outlet and the storage tank. The loop is manually energized by switching on a circulating pump and burner, and is set to hold heater outlet water at 180°F.

10. EQUIPMENT AND INSTRUMENTATION

Absorption

Analyze Absorption in Gas Separations. J. Coates and B. S. Pressburg. *Chem. Eng. 67,* 99 (1960) Oct. 3 (6 pp.)

Material and energy balances, transfer rates and equilibrium govern the separation of material from gas to liquid phase during absorptions that occur in plate towers and packed columns.

Automation

Q: What Can Automation Save Us? A: Plenty! J. L. Turnan. *Am. Gas J. 187,* 22 (1960) Sept. (3 pp.)

Machines may never replace humans completely, but controls, instrumentation, computers, etc., can improve operating efficiencies in gas distribution operations and make the human factor even more valuable. Author discusses corrected Q computers, peak shaving with holders, propane-air peak shaving, automation in distribution and booster regulators.

Controls

Chromatography for Process Control. T. C. Wherry. *Chem. Eng. Progress 56,* 49 (1960) Sept. (9 pp.)

Applications of chromatographs in the chemical industry, particularly as process monitors, are becoming legion; however, with the development of high-speed units, the future utilization in process control also appears promising. The techniques are applicable to many operations such as fractionation, extractive distillation, catalytic and chemical reactors, trace analysis, etc. Investment costs in many operations have been realized within a year due to increased production, improved product quality, and reduced operating costs.

Industrial Control with Pressure Regulators. G. Chinn. *Chem. Eng. Progress 56,* 58 (1960) Sept. (2 pp.)

Increasing emphasis being placed upon sophisticated control instrumentation has relegated the pressure regulator to the category of hardware. Though it probably is the oldest type of industrial control, and can be replaced by a variety of more advanced methods, it still remains one of the most valuable process-control components. A thorough understanding of the capabilities and limitations of this simple device will enable a design engineer to provide a less complex and less expensive control solution than can be achieved with more sophisticated control methods.

Pneumatic or Electronic: Which System? J. R. Connell. *Can. Chem. Processing 44,* 36 (1960) Sept. (4 pp.)

Electronic vs. pneumatic debate is one of the big questions in current instrumentation practice and theory. The question is not an absolute one, of course. Many manufacturers make both these major types of instruments, many users use both. Pneumatic systems still predominate in existing process industry plants, but electronics are coming fast. Are electronic systems, at their current stage of development, adequate to meet the needs of the modern process plant?

Fluid Flow

Apparatus for the Measurement of Gas Velocity in Furnaces and Models. A. E. Pengelly. *J. Sci. Instruments 37,* 339 (1960) Sept. (8 pp.)

Range of Pitot tubes is described together with an electromagnetic transducer micromanometer. The assembly is designed for the measurement of gas velocity over a large range of temperature, and pollution velocities as low as 40 cm/sec. Some applications are described.

Gas Turbines

Gas-Turbine Electric Plant in Venezuela. *Mech. Eng. 82,* 58 (1960) Sept. (4 pp.)

Gas turbines were selected as prime movers because of low initial cost, low water requirements, and low operational and maintenance costs. The use of waste heat was not considered feasible because heat loads in sufficient quantity were not concentrated near the various prospective plant sites. The decision to use gas turbines was a bold one since this plant was to be, and possibly still is, the only isolated generating station using gas turbines exclusively for prime movers. The original plant consisting of three 5000-kw turbogenerators and substation was completed in the latter part of 1955. A fourth unit was added in 1958 and the fifth was placed on-the-line May 1, 1959. The central power system includes the central power plant and its substation; 144 miles of 69-kv transmission lines, 13 miles of 33-kv transmission; nine 69/13.8-kv substations, one 69/2.4-kv substation and five 34.5/2.4-kv substations.

Instruments

Instrument Maintenance "Backtalk." C. R. Skalnik. *Petro/Chem. Eng. 32,* C-34 (1960) Sept. (3 pp.)

Once a new instrument is selected, maintenance planning begins. The first phase is a familiarization and training session for the technician who will maintain it. Training is expensive and must be well planned to gain maximum efficiency. It is necessary to get complete manufacturer's detailed drawings as far in advance of instrument delivery as possible. Also, it is desirable to favor manufacturers who have local offices in close contact with their maintenance experts. In this way, a large part of the training can be given by the people

most familiar with the instrument and its application to the hydrocarbon process industry.

Piping

Let's Go After the Cause of Piping Vibration. J. P. Chamberlain. *Petro/Chem. Eng. 32,* C-30 (1960) Sept. (4 pp.)

Author tries to explain the causes of piping vibration without giving any of the mathematics of vibration. There is no general analytical solution available. Rather, the nature of free, forced and self-excited vibrations are discussed to enable a better understanding of the limits of safety.

Radioactivity Applications

Radiation Techniques for Process Measurements. A. H. McKinney. *Chem. Eng. Progress 56,* 37 (1960) Sept. (12 pp.)

Penetrating radiation can give valuable information concerning process conditions that are not available by other methods. By judicious placement of the equipment, measurements such as level, density, concentration, viscosity, flow rates, etc., can be obtained. The components for a required installation are readily available, but most installations will require source sizing and placement calculations. Included are charts, previously unpublished, for reducing differential equations and trial-and-error problems to simple algebra for various geometrical arrangements. Article tells how to make various measuements and provides the details to solve typical problems.

Shock Tubes

Chemical Shock-Tube Research. V. Kevorkian. *Chem. Eng. 67,* 107 (1960) Sept. (6 pp.)

Article is written to acquaint engineers with unique high-temperature short-time reactor. It explains what a chemical shock tube is, how it operates, and the reaction conditions it is capable of attaining.

Valves

Safety Device for Apparatus Using Fuel Gases. A. H. Frecourt (assigned to L. Simon Poursin.) U.S. 2,950,755 (1960) Aug. 30.

Improved safety shut-off device is claimed for apparatus using fuel gases. This comprises two gas-control valves in series in the line to the main burner, either capable of cutting the feed to the burner. A thermal element controls the second valve, and is heated by a burner fed only when the first valve is open. The first valve is controlled by a thermostatic valve in the heating equipment, and if the temperature rise is excessive, a manual reset cut-off prevents the second valve from opening regardless of the first valve setting.

Welding

Fundamental Studies of Ultrasonic Welding. N. E. Weare, J. N. Antonevich and R. E. Monroe. (Reprint from *Welding J. Res. Supplement,* (1960) Aug. (11 pp.)

Studies related to ultrasonic welding were made to determine the mechanism of bonding, the effects of welding variables and the effects of material factors. Experimental procedures and results are discussed.

Maintenance Welding. W. H. T. Svanoe. *Mech. Eng. 82,* 64 (1960) Sept. (3 pp.)

Many of the welding methods introduced in industry to meet the specific needs of metals fabrication have application in maintenance welding. For economy and reliability in plant-maintenance work, those methods should include oxyacetylene, metal-arc, nonconsumable-electrode inert-gas-shielded welding and consumable-electrode inert-gas-shielded welding especially with midget guns, and, to a limited extent, submerged-arc welding. For thermal cutting, in addition to the oxyacetylene method for steel, methods for alloys and nonferrous metals are needed. These would include carbon-arc air gouging, inert-gas cutting, or, in lieu of the inert-gas method, iron-powder cutting.

11. MATERIALS OF CONSTRUCTION, AND CORROSION

Cathodic Protection

An Expanding Utility Uses Cathodic Protection. E. W. Fallis. *Corrosion 16,* 20 (1960) Sept. (2 pp.)

Some of the details and troubles experienced by the Kingston, Ontario, Public Utilities Commission in installing and protecting cathodically its water and gas lines and an elevated water tank are described. Cost data are given on protecting 31,000 feet of gas line.

Cathodic Protection of Glass-Lined Domestic Water Heaters. H. C. Fischer. *Corrosion 16,* 9 (1960) Sept. (7 pp.)

Factors important in designing a cathodic protection system for glass lined domestic hot water heaters are considered. Method by which bare areas of single coated glass lined tanks can be calculated is explained, and comparisons are made between calculated values and those obtained by tests on tanks under protection. Instruments for making these tests and techniques are illustrated and described.

Criteria for Cathodic Protection. W. von Baeckmann and G. Heim. *Gas u. Wasserfach 101,* 942 (1960) Sept. 9 (7 pp. German text.)

Rather complete review of recent studies of cathodic protection is given. This includes protection-current density, phase boundary potentials, resistance-drop and localized electrolytic cell effects as the critical factors having influence on pipeline corrosion.

Coatings

Plastic-Coated Steel Pipeline to Usher Gas Through Corrosive Pa. Land Tract. *Pipe Line News 32,* 49 (1960) Sept.

Over 42,000 ft of a special plastic-coated steel pipeline, Republic Steel Corp.'s X-Tru-Coat, was installed between the United Refining Co.'s tank and refinery in Warren, Pa. After welding, the exposed joints were wrapped with a special pressure-sensitive plastic tape

to keep out moisture. Republic supplies a yellow polyethylene tape with a suitable primer for joint protection. The coating is of high-density polyethylene and is extruded directly over the steel pipe. A special adhesive compound is used to bond the coating and the pipe, preventing underfilm migration.

Protective Coatings on Well Casing. W. R. Lambert. *Petrol. Eng. 32,* B-52 (1960) Sept. (3 pp.)

Protective coatings and cathodic protection can save many of the millions of dollars spent each year by the industry in the battle against casing corrosion. Recent downhole tests of several coatings and wraps have proved the value of such preventive maintenance to protect casing strings, usually the single most expensive components of a well completion.

Rust Prevention with New System Prior to Stove Enamelling. N. R. MacCleaster. *Corrosion Tech. 7,* 284 (1960) Sept. (3 pp.)

Recently, the method of applying Dox-Anode zinc silicate to a preheated surface has been advanced, and a new system for applying zinc to metal, rendering the surface phosphated and primed, is now available. This system eliminates the usual phosphating operation with, it is claimed, better results. This hot-spray system requires no de-rusting, the adherent rust forming a key to receive the zinc silicate coating.

Corrosion

Bacterial Corrosion of Underground Pipes. L. T. Minchin. *Coke and Gas 22,* 392 (1960) Sept. (7 pp.)

Wet, neutral "anaerobic" soil is often one of the most destructive environments an iron or steel pipe could have. This is due to the activities of a type of bacteria which occurs widely in nature and which has the power of reducing sulfates. If iron is present, this metabolic process results at the same time in the corrosion of the metal. If the soil is alkaline, the bacteria become dormant, and then very little corrosion will normally occur. Consequently, a soil survey can often indicate the areas where corrosion is likely to be severe, and where, in consequence, the maximum protection is necessary.

Microbially Induced Corrosion. W. Summer. *Corrosion Tech. 7,* 287 (1960) Sept. (2 pp.)

Of the several causes of corrosion, bacteria form the least well-known single group of agents. It may appear strange that microbes should cause metals to corrode. However, it is not the bacteria but their metabolic products which are the causative agents. Discussion of the metabolic principles involved describes the type of corrosion to be expected and indicates methods of prevention.

Qualitative Mechanism of Stress Corrosion Cracking of Austenitic Stainless Steels. D. Van Rooyen. *Corrosion 16,* 421t (1960) Sept. (9 pp.)

Tests results support the electrochemical mechanism of stress corrosion crack initiation in austenitic stainless steel. After a period of initiation, during which partial passivation occurred, local anodes corroded along certain narrow planes, resulting in cracking and ultimate failure. Crack lengths gradually increased with time, after the onset of stress corrosion crack propagation, and no cracking took place during the initiation stage. Unlike a brittle fracture, which propagates very rapidly, the cracks extended slowly and gradually through austenitic stainless steels and a magnesium-base alloy without any steps of instantaneous advance. Crack propagation in mild steel, placed in hot nitrate solutions, took place in alternating steps of rapid and slow penetration. The rapid steps were not instantaneous. The stress corrosion cracking of aluminum-4 percent copper and aluminum-7 percent magnesium alloys, in sodium chloride-sodium bicarbonate solutions, consisted of alternating stages of electrochemical corrosion and sudden physical failure. Study methods used include the automatic recording of electrochemical potential change and extension of specimens and the acoustic recording of sound generated during cracking.

Where to Use Corrosion Probes. (From a paper by E. S. Troscinski, A. S. Couper and A. Dravnieks.) *Oil Gas J. 58,* 203 (1960) Sept. 26 (2 pp.)

Corrosion probe is the most sensitive method in use for detecting and measuring corrosion. Since it can measure losses as small as a few millionths of an inch, the probe's accuracy allows corrosion rates to be determined rapidly. Continuous corrosion monitoring is possible because probes may be installed at any point in the unit and measurements can be obtained without interfering with normal operations.

Graphite

Graphite for Heat Exchangers. A. Hilliard. *Chem. & Process Eng. 41,* 416 (1960) Sept. (3 pp.)

The Polybloc system for constructing chemical plant makes use of unit blocks of graphite with short passages. It is an interesting example of the necessity to design equipment around the unique properties of each material of construction, without reference to prior art. Thus this system results in improved mechanical and corrosion properties as well as utilizing to the full extent the excellent thermal conductivity of graphite, author says.

Materials of Construction for Chemical Plant. Graphite. K. F. Anderson, F. K. Earp and S. Shapiro. *Chem. & Process Eng. 41,* 409 (1960) Sept. (7 pp.)

Although carbon is the correct term describing mesomorphous carbon, natural graphite and electrographite, engineers commonly use the term graphite when specifying one member of the carbon family suitable for chemical plant. The physical properties of graphite differ markedly from metals and hence special design characteristics have to be taken into account. Article surveys the general applications of graphite in chemical plant—an increasing trend due to the extraordinary chemical properties of this material.

Insulation

Thermal Insulation. Some Basic Considerations. J. W. Dawson. *Chem. & Process Eng. 41,* 406 (1960) Sept. (2 pp.)

In order to establish what would be the ideal size and kind of cell or pore to produce the maximum resistance to heat flow, it is necessary to resort to elementary physics. A new technique, known as vacuum powder insulation, is being used on a commercial scale to exploit the principle involved. One of the materials used —perlite—is heat treated to produce a lightweight aggregate having remarkably small and evenly distributed pores. Silica aerogel has a similar structure with even smaller pores.

Thermal Conduction and Its Special Application to Thermal Insulation. H. K. Suttle. *Chem. & Process Eng. 41*, 397 (1960) Sept. (8 pp.)

Author describes the broad concepts of the theory of heat transfer, thermal conduction and its application to thermal insulation.

12. ANALYTICAL METHODS AND TESTS

Analytical Instruments

An Analyzer for Your Process Stream? H. C. McIntyre. *Can. Chem. Processing 44*, 42 (1960) Sept. (5 pp.)

Analytical instrumentation has for years played an important laboratory role in the improvement of product quality, product control, and plant efficiency. Now this type of instrumentation is moving rapidly from the laboratory into the plant in the form of on-stream devices. The transition from the lab to the plant is the result of new thinking and new developments. Canadian plant managers are aware of the benefits to be derived from on-stream, end-point analyzers in optimizing plant efficiency and improving product quality by direct monitoring of the process.

Chromatography

Applications of Carbowax 400 in Gas Chromatography for Extreme Aromatic Selectivity. L. R. Durrett. *Anal. Chem. 32*, 1393 (1960) Oct. (4 pp.)

Gas chromatography procedure for analysis of petroleum samples is modified to use Carbowax 400 as the stationary liquid phase. The new technique offers greater retention selectivity for aromatic hydrocarbons, as well as superior determination of hydrocarbon impurities in high purity petroleum benzene and toluene.

Factors Affecting the Use of Gas-Liquid Chromatography for the Separation of Large Samples. The Column Dimensions. W. J. deWet and V. Pretorius. *Anal. Chem. 32*, 1396 (1960) Oct. (4 pp.)

Efficiency of a gas-liquid chromatography column is investigated in regard to effect of the dimensions of the column. Maximum sample volume increases as column length or column diameter increases. An equation is devised relating column efficiency to sample volume.

Qualitative Functional Group Analysis of Gas Chromatographic Effluents. J. T. Walsh and C. Merritt, Jr. *Anal. Chem. 32*, 1378 (1960) Oct. (4 pp.)

Direct, rapid method of qualitative gas chromatographic analysis employs retention time data and functional group classification. A systematic use of chemical reactions gives positive identification of components in mixtures. The procedure also defines chromatographic peaks as to whether they are of one or more components.

The Use of a Carbon Monoxide Flame Detector in Gas Chromatography. C. B. Baddiel and C. F. Cullis. *Chem. & Ind.*, 1154 (1960) Sept. 10 (2 pp.)

In the flame detector originally devised for use in gas chromatography, either hydrogen or a mixture containing hydrogen has generally been employed as the carrier gas. One disadvantage of hydrogen is its high diffusion coefficient compared with that of air and of the majority of substances being analyzed. The possibility has been investigated of using carbon monoxide as the carrier gas. This compound has a low diffusion coefficient and its use largely avoids the formation of hydrogen halides (and of water vapor) in the flame.

Coal

Rapid and Precise Determination of Total Sulphur in Coal. A. C. Bhattacharyya and B. P. Bhaduri. *J. Sci. & Ind. Research 19B (Physical Sciences)*, 212 (1960) June (3 pp.)

Rapid and precise method for determining total sulfur in coal, based on the combustion of coal samples (0.1-0.2 g) in platinum-rhodium gauze catalyst, has been developed. Total sulfur after combustion is converted into sulfur dioxide and sulfur trioxide which are absorbed in hydrogen perioxide to form sulfuric acid. Sulfur is finally estimated as barium sulfate gravimetrically. The analytical values obtained agree closely with those obtained by the Eschka method and are reproducible. The rapidity of the method can be increased by chelometric determination of barium sulfate by EDTA.

Coal Ash

A Study of the Fusion Characteristics of Coal Ashes: Softening Temperature of Coal Ashes in Oxidizing Atmosphere. B. K. Dutta, B. Rai and K. R. Chakravorty. *J. Sci. & Ind. Research 19B (Physical Sciences)*, 206 (1960) June (7 pp.)

Study of the fusion characteristics of ashes of coals from different sources has been carried out with particular reference to the effect of addition of lime, magnesia, alkali oxides, ferric oxide, alumina and silica on the softening temperature of the ashes in an oxidizing atmosphere; synthetic ashes of similar composition have also been prepared and tested. A close correlation has been observed between softening temperature of coal ash and its lime, magnesia, alkali oxides, ferric oxide, alumina and silica contents. Based on this correlation, a method has been worked out for predicting the softening temperature of coal ashes in an oxidizing atmosphere from their chemical composition.

Hydrocarbons

Fluorescence Spectra of Aromatic Hydrocarbons and Heterocyclic Aromatic Compounds. B. L. Van Duuren. *Anal. Chem. 32*, 1436 (1960) Oct. (7 pp.)

Application of fluorescence spectroscopy in the qualitative and quantitative analysis of aromatic compounds was investigated. Among other things, the effect of concentration on fluorescence intensity was examined.

Rapid Chemical Determination of Iron, Nickel, and Vanadium in Petroleum Oils. J. S. Forrester and J. L. Jones. *Anal. Chem. 32,* 1443 (1960) Oct. (4 pp.)

Trace amounts of iron, nickel, and vanadium in petroleum oils are rapidly determined by colorimetric procedure. Sample is decomposed by perchlorate ashing and aliquots taken for the various determinations. Bathophenanthroline is the reagent for iron, while α-furil dioxime is used for nickel and 3,3-dimethylnaphthidine for vanadium.

Mass Spectrometry

Dual-Inlet System for a Mass Spectrometer. G. L. Cook, R. A. Meyer and D. G. Earnshaw. *U.S. Bur. Mines Rep. Invest. 5663,* (1960) 8 pp.

Design of a dual-inlet system for a Consolidated model 21-103C mass spectrometer is described in detail. The system permits both high-mass and low-mass samples to be run by using a single instrument. The difficulties of using a single instrument for both purposes are given and a method of minimizing these difficulties through the use of the present design is discussed. After examining the experience of five years of use, the conclusions are that the bimodal operation is practical and the low-mass analyses had nearly the same precision as before the modifications to the instrument were made.

High Resolution Mass Spectrometry. Interpretation of Spectra of Petroleum Factions. E. G. Carlson, G. T. Paulissen, R. H. Hunt and M. J. O'Neal, Jr. *Anal. Chem. 32,* 1489 (1960) Oct. (6 pp.)

Double-focusing coincident-field mass spectrometer is adapted for operation with high boiling petroleum fractions. New techniques are developed for petroleum components and certain molecular type fractions are established which have not previously been known or were known only by indirect evidence.

Particle Size

Apparatus for Counting Particles. J. W. Phillips, D. G. A. Thomas and W. H. Walton (assigned to Coal Industry (Patents) Ltd.) U.S. 2,948,469 (1960) Aug. 9.

Samples of particles in dust clouds are settled on a collecting surface and the collected particles are counted and their sizes determined. Invention provides an apparatus for determining the number and/or size or distribution of sizes of elements by scanning along a succession of substantially parallel lines by a beam of radiation or charged particles. Each time the beam traverses an element an electric signal is produced, and a count of the signals is obtained, each signal being temporarily recorded on a continuous magnetic sound track.

Water

The Determination of Water in Gaseous Hydrocarbons: Fischer Reagent Method. *J. Inst. Petrol. 46,* 294 (1960) Sept. (5 pp.)

Method most commonly employed in examining gaseous samples for water content is the Karl Fischer reagent Method has its limitations; it is subject, for example, to interference by various sulfur compounds, and difficulties can arise if it is applied to samples of C_3 hydrocarbons. However, it is believed that the representative procedure described may be of interest to others, particularly those with little or no experience in this type of analysis.

13. BASIC SCIENCE

Adsorption

Adsorption Studies on Metals. IX. The Nature of the Thermal Regeneration of Oxide-Coated Nickel, Cobalt and Copper. A. C. Zettlemoyer, Y-F. Yu and J. J. Chessick. *J. Phys. Chem. 64,* 1099 (1960) Sept. (4 pp.)

Organic vapors were used in investigation as a probe for any bare metal surface uncovered during regeneration. The heats of adsorption of *n*-propylamine and acetic acid on the bare, oxide-coated and regenerated metal surfaces support the contention of one investigator that re-crystallization occurs. That is to say, initial heats of adsorption were much higher on the regenerated surfaces, in accord with the values for the freshly reduced metals, and were much lower on the oxide-coated surfaces. The extents of irreversible adsorption followed the pattern to be expected from the heat measurements.

The Failure of Dispersion Energy Calculations to Reproduce Heats of Adsorption on Graphitic Carbon. D. Graham. *J. Phys. Chem. 64,* 1089 (1960) Sept. (4 pp.)

Isosteric heats of adsorption of nitrogen on diamond, amorphous carbon, and thermally graphitized P-33 differ but little at the coverage approaching completion of the first monolayer. The effect of the much greater density of diamond is thus balanced by a correspondingly greater contribution (per atom) from the electrons of the graphitic carbons. Calculated dispersion energies fail to reproduce this result, indicating the possible importance of other forms of electronic interaction.

Hydrogen Sorption on Graphite at Elevated Temperatures. J. P. Redmond and P. L. Walker, Jr. *J. Phys. Chem. 64,* 1093 (1960) Sept. (7 pp.)

Sorption of hydrogen on selected types of nuclear and spectroscopic graphite has been studied, and from the results of the investigations it is concluded that the adsorption of hydrogen occurs on carbon atoms at the edge of crystallites and that significant intracrystalline sorption does not occur.

Compressibility

Compressibility Factor of Natural Gases at 60°F and One Atmosphere. D. McA. Mason and B. E. Eakin. (Amer. Chem. Soc., Division of Gas and Fuel Chem., Preprints of Papers Presented at New York, Sept. 11-16, 1960.) 12 pp.

Two four-component mixtures were prepared and their gas law deviations measured to test methods of predicting the compressibility factors of complex mixtures. The measured values are presented in tabular form together with values calculated by various methods. Results indicate that the compressibility factor of complex mixtures can be calculated by two of the three methods described, with an accuracy of 0.03% or better. This represents a distinct improvement over the third method, the linear combination. It is recommended that the heating value be calculated on the basis of the ideal gas heating values, and be corrected for nonideality by the mixture compressibility factor, calculated by either of the combining rules recommended on the basis of the investigation.

Fluid Flow

Adding Precision to the Hydraulic Calculation for a Pipe Conduit Working at High Pressure in Conditions of Isothermal Motion of the Gases. L. I. Kudryashev and M. Y. Sychev. *Izv. Vyssh. Uchebn. Zavedenii Energetika*, 76 (1958) No. 4 (5 pp. Russian text); *Ref. Zh. Mekh.* Rev. 1308 (1959) No. 2. (From *Appl. Mech. Rev. 13*, 663 (1960) Sept.)

It is shown that when determining the hydraulic resistance in pipe conduits of great length it is impossible to disregard, as is done in the deduction of the widely applied Weymouth formula, the inertia term in the equation for impulses. Taking into account the inertia term in the impulse equation, authors derive a formula for the determination of the consumption of gas in the gas conduit where the Weymouth input is corrected in terms of pressures and Mach number.

V. D. Sokolov
Courtesy Referativnyi Zhurnal, USSR

Change of Pressure in an Extensive Gas Conduit When the Flow of Gas Is Not Steady. O. L. Sinil'nikova. *Gaz. Prom-st'*, 48 (1958) No. 5 (3 pp. Russian text); *Ref. Zh. Mekh.*, Rev. 1309 (1959) No 2 (From *Appl. Mech. Rev. 13*, 663 (1960) Sept.)

Problem is solved regarding the change in gas pressure in the main with a variable withdrawal of gas from the conduit at one end and a simultaneous constant inflow of gas at the other. In the equations of the even motion of an incompressible gas in the isentropic process, a linearization of the third term takes place.

V. D. Sokolov
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Dynamics of the Turbulent Free Jet. P. D. Sunavala. *J. Sci. & Ind. Research 19B (Physical Sciences)*, 35 (1960) Feb. (11 pp.)

General free jet equation has been derived from compressible fluid flow theory which, in conjunction with data on thrust measurements, enables the deduction of the axial decay curve for any jet operating at any nozzle pressure and exit temperature in the subsonic range. The pressure correction factor in the equation has been found to decrease at higher subsonic pressures; this is attributed to a decrease in the thrust or nozzle efficiency. A new technique of measuring burner thrusts based on the rotating fountain principle has been devised.

Entrainment and Pressure Drop in Concurrent Gas-Liquid Flow: 1. Air-Water in Horizontal Flow. M. Wicks and A. E. Dukler. *A.I.Ch.E. J. 6*, 463 (1960) Sept. (6 pp.)

Experimental equipment and data are reported for entrainment and energy loss in annular, two-phase flow of water and air. Measurements were obtained with a sample withdrawal technique in 1- and 3-in. horizontal tubes. A knowledge of entrainment is necessary to an understanding of various mass transfer, heat transfer and separation problems in two-phase flow. A preliminary correlation is presented.

Experimental Determination of Statistical Properties of Two-Phase Turbulent Motion. S. L. Soo, H. K. Ihrig, Jr. and A. F. El Kouh. *J. Basic Eng. 82*, 609 (1960) Sept. (13 pp.)

Experimental methods for the determination of certain statistical properties of turbulent conveyance and diffusion of solid particles in a gaseous state are presented. Methods include a tracer-diffusion technique for the determination of gas-phase turbulent motion and a photo-optical technique for the determination of motion of solid particles. Results are discussed and compared with previous analytical results.

Influence of a Liquid on the Motion of a Gas Along Vertical Tubes. Y. P. Korotaev. *Trudi Vses. Nauk-i. In-ta Prirodn. Gazov*, 48 (1958) No. 2 (21 pp. Russian text.); *Ref. Zh. Mekh.* Rev. 1632 (1959) No. 2. (From *Appl. Mech. Rev. 13*, 662 (1960) Sept.)

Motion of a gas and a gas-saturated liquid is investigated theoretically and experimentally in order to determine the values of the coefficients of resistance to friction in the shafts of gas wells. The experimental investigation was carried out on a specially built apparatus at pressures of less than 2 atm and on industrial gas and gas-petroleum wells. It was established that when only a small quantity of liquid was involved the values of the coefficient of friction are smaller than in the motion of a pure gas.

N. S. Kontrat'ev
Courtesy Referativnyi Zhurnal, USSR

Low-Pressure Gas Flow in Consolidated Porous Media. Part 1. Flow Through a Porous Ceramic. R. A. and D. M. Grove. *Trans. Faraday Soc. 56*, 1357 (1960) Sept. (13 pp.)

Experiments have been carried out near room temperature on low-pressure gas flow through a porous porcelain ceramic made in the form of a cylindrical rod about 0.3 cm in diam. and nearly 50 cm in length, the flow occurring along the axial direction only. The gases used were the inert gases, hydrogen, nitrogen, oxygen, ethane, carbon dioxide and sulfur dioxide. For the permanent gases it has been shown that the product of the steady-state permeability and the transient state time-lag remains subsantially constant throughout the pressure range studied. Anomalous results are obtained for sulfur dioxide and, to a much less marked degree, for carbon dioxide. It is shown that these results can provide information about the adsorption occurring.

Short Cut to Pressure-Drop Calculations. J. O. Ball. *Oil Gas J. 58,* 99 (1960) Oct. 3 (4 pp.)

Method described uses only those variables which are found in the standard Fanning pressure-drop equation and the Reynolds number. It is short, simple and accurate for all cases which have been checked, claims author. It can be used to determine the pressure drop for turbulent flow of varying density fluids—liquids, gases or mixtures of the two—in short lengths of process piping such as condensing coils and furnace tubing.

Heat Transfer

Infrared Radiometry. R. K. McDonald. *Instruments & Control Systems 33,* 1527 (1960) Sept. (4 pp.)

Thermal radiation is such a universal property of matter that it is only absent when the matter is a monatomic gas like helium, or is at absolute zero temperature. Symmetrical diatomic gases such as the nitrogen and oxygen in air are for practical purposes also nonemitters of heat energy. A radiometer directly measures the radiant energy emitted by a body. In many cases this is sufficient information; but frequently the desired quantity is the actual temperature of the emitting surface. Then one must know how much heat has been absorbed by the intervening atmosphere, and something of the object's ability to emit radiation (emissivity). This property represents the ratio of emitted energy to the theoretical maximum radiated by a black body at the same temperature.

Thermal Transfer in Turbulent Gas Streams. Effect of Turbulence on Local Transport from Spheres. W. W. Short, R. A. S. Brown and B. H. Sage. *J. Appl. Mech. 27,* 393 (1960) Sept. (10 pp.)

Present investigation was undertaken because of the paucity of data concerning the effect of turbulence upon local thermal transport from spheres in a free stream. A series of measurements was obtained of the local thermal transport in the forward hemisphere and a part of the after hemisphere of a silver sphere 0.5-in. diam. The measurements were made in an undisturbed air stream and at several positions in the wake of a grid inserted in the air stream. The apparent level of longitudinal turbulence was varied between 0.013 and 0.15 for Reynolds numbers up to 3600. At an apparent level of turbulence of 0.013 and a Reynolds number of 3600 the local thermal transfer varied by a factor of eight around the sphere. Increasing the apparent level of turbulence to 0.15 increased the over-all thermal transfer 20%. The local thermal transfer varied by a factor of five at the latter level of turbulence.

Hydrocarbons

Applied Hydrocarbon Thermodynamics. Part 21. Nomographs and Convergence Pressure Correlations of Vapor Liquid K-Values. W. C. Edmister. *Petrol. Refiner 39,* 293 (1960) Sept. (10 pp.)

From previous discussions in the series, it is evident that the correlation and prediction of the equilibrium vapor-liquid phase distribution ratios for hydrocarbon mixtures is a very complex subject. Two empirical techniques are frequently used for hydrocarbons: nomographs and convergence pressures. By the use of alignment charts or nomographs, more compact empirical correlations of vapor-liquid K-values may be obtained. The effect of composition on the K values of the components of hydrocarbon mixtures can frequently be represented by the convergence pressure, which has been used with the log K vs log P and the nomographic correlations. Both of these correlating techniques are discussed.

Propane

Gamma Radiolysis of Propane. F. Birdwell and G. W. Crawford. *J. Chem. Phys. 33,* 928 (1960) Sept. (2 pp.)

Propane gas has been irradiated with cobalt-60 gamma rays. The primary products formed by the decomposition of 0.9-3.2% of the original propane have been identified. Based on hydrogen yield, the relative yields of the products are: hydrogen (1.00), hexanes (0.70), ethane (0.32), methane (0.27), butanes (0.17), and pentanes (0.08).

Radiation

How Radiation Affects Engineering Materials. R. E. Bowman. (Reprint from *Materials In Design Engineering Manual No. 173.*) July 1960.

Radiation has been added to the growing list of combined environments that the engineers must now consider. Article gives an up-to-date summary of how it affects commonly used materials such as structural metals, inorganic nonmetallics, elastomers, plastics and organic fluids.

Viscosity

Liquid, Gas, and Dense-Fluid Viscosity of Propane. K. E. Starling, B. E. Eakin and R. T. Ellington. *A.I.Ch.E. 6,* 438 (1960) Sept. (5 pp.)

Experimental data, believed accurate within ±0.5%, are presented for pressures of 100 to 8000 psia for nine temperatures from 77° to 280°F. One isotherm, within 1° of the critical, indicates the detail required in further investigation of the critical region. These data were combined with the available literature values to prepare a table of recommended viscosity values with maximum uncertainty of ±2% for temperatures from 70° to 460°F. Two generalized correlations and the Enskog viscosity theory for dense gases exhibit significant errors in predicting the data. Methods are suggested for extrapolation of the values to higher temperatures and pressures.

Liquid Viscosities above the Normal Boiling Point for Methane, Ethane, Propane and *n*-Butane. G. W. Swift, J. Lohrenz and F. Kurata. *A.I.Ch.E. J. 6,* 415 (1960) Sept. (5 pp.)

Viscosities, obtained with a falling cylinder viscometer, are presented for liquid methane, ethane, and propane from their normal boiling points to their critical points and for *n*-butane from its normal boiling point to 100°C. The data are compared with those of other investigators.

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Air Engineering
Air Pollution Control Association, Journal of
American Chemical Society, Journal of
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